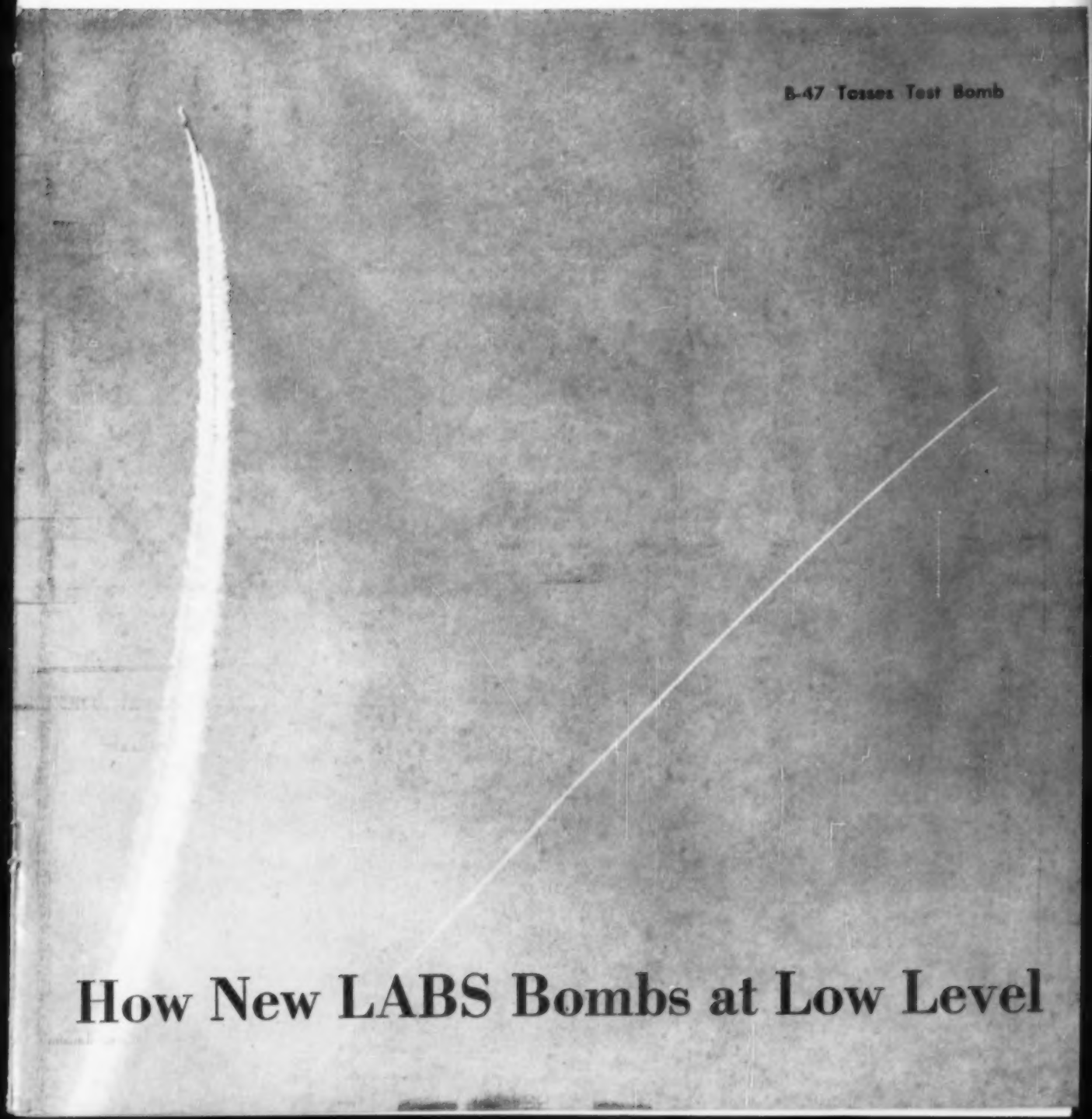
AVIATION WEEK

A McGRAW-HILL PUBLICATION

July 22, 1957 50 cents

QPRI Programs Match Personnel To Weapon Systems



B-47 Tosses Test Bomb

How New LABS Bombs at Low Level

NOW—

Kaylock offers their new style counterbored lightweight nuts in A-286 Corrosion Resistant Steel

Proof again

KAYLOCK®
All-Metal Self-Locking Nuts

has become the symbol of Leadership—through advanced development that provides tomorrow's parts today.

Weight — Lightweight designs save up to 60% compared to others.

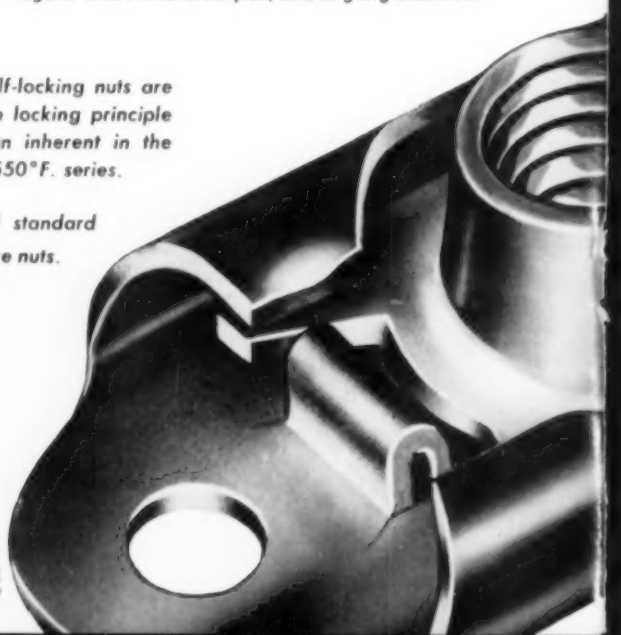
Physical Properties — A-286 has excellent values to 1200° F.

Magnetic Permeability — Exceptionally low. Nuts are usable wherever non-magnetic materials are required.

More complete than any other line. Following parts available in thread sizes #4-40, #6-32, #8-32, #10-32, 1/4-28 and 5/16-24: hex nuts and in two-lug, one-lug, corner type fixed anchor nuts and floaters (both regular and miniature styles) and in gang channels.

Kaylock extra high temperature self-locking nuts are precision products utilizing the same locking principle and low height, full strength design inherent in the standard Kaylock high temperature 550°F. series.*

**Above the 550°F. limits of standard Kaylock high temperature nuts.*



For more information write:

THE KAYNAR COMPANY • KAYLOCK DIVISION AW7 • BOX 2001, TERMINAL ANNEX
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TWICE THE HUSTLE

with HALF THE MUSCLE!

Today, thanks to *a complete ground support system* conceived, designed and engineered by Goodyear Aircraft Corporation, missile squadrons have more "hustle" — require but a fraction of the "muscle" previously expended to transport, set up and go into action.

- The number of vehicles required has been drastically reduced.
- Only one engine type — already in world-wide Air Force inventory — is employed. It provides the power needs for vehicles as well as electronics and maintenance equipment.
- Now only one type prime mover of "universal design" is required. It can execute any movement required within the squadron, carry any one of the specially Goodyear-engineered "packs" of ground-handling equipment, and haul the launchers which were also built by Goodyear Aircraft.
- Each pack can be "telescoped" for clearance. As a result, trucks and entire system are air-transportable — easily moved to strategic areas in a hurry.
- Once there, the squadron can traverse terrain heretofore impassable — even through swampy areas, change location in a matter of hours — thanks to the huge, low-pressure "Go-Anywhere" Terra-Tire developed by Goodyear.

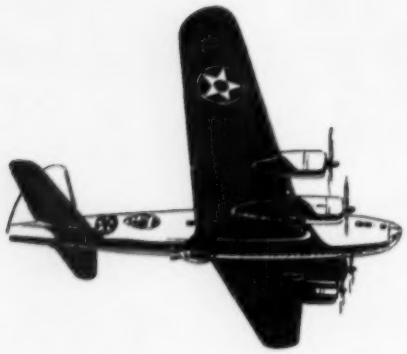
This astonishing mobility, adaptability and practical logistics owes its success to a new design concept—engineered and executed to the smallest detail by Goodyear Aircraft.

They're doing big things at

GOODYEAR AIRCRAFT

Plants in Akron, Ohio, and Litchfield Park, Arizona
Rewarding Challenges and Careers for Engineers

Terra-Tire—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio



Another
famous
plane

PROVEN IN SERVICE

1941

Four days after Pearl Harbor, a Boeing B-17 Flying Fortress scores three direct hits on a 29,000 ton Japanese battleship. It's the first American air victory of World War II.

During the hectic days of World War II the dependable B-17 proved itself in service. And, even then, 16 history-filled years ago, Rockbestos high temperature wire was well known to the aviation industry — had earned a proven-in-service reputation.

Long an important part of the aircraft industry, Rockbestos has continually produced high temperature wire which meets the exacting standards of modern airplanes . . . both military and commercial.

Rockbestos will continue to develop wires to meet the aircraft industry's needs. Find out just how Rockbestos can help solve your high temperature wiring problems. Write, wire or phone for complete specifications and application information.

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AVIATION CALENDAR

July 28—Third Annual Jaycee Air Fair, sponsored by Portland (Oregon) and Junior Chamber of Commerce, Portland International Airport.

July 31-Aug. 4—Eleventh Annual National Convention, and Airpower Panorama, Air Force Assn., Sheraton-Park and Shoreham Hotels, Washington, D. C.

Aug. 1-2—Second Annual Exiborama and First Annual National Photo Instrumentation Symposium, Society of Photographic Instrumentation Engineers, Ambassador Hotel, Los Angeles.

Aug. 5-10—National Naval Aviation Meeting, Institute of Aeronautical Sciences, U. S. Grant Hotel, San Diego, Calif.

Aug. 10-11—Midget Airplane Races, Oshkosh, Wis.

Aug. 17—Open house for pilots and public, Piper Aircraft Corp., Lock Haven, Pa.

Aug. 20-22—Bendix-Scintilla International Ignition Conference, Sidney, N. Y.

Aug. 20-23—Western Electronic Show & Convention, Cow Palace, San Francisco.

Aug. 26-28—Gas Dynamics Symposium Transport Properties in Gases at High Temperatures and Pressures, Technological Institute, Northwestern University, Evanston, Ill.

Aug. 31-Sept. 1—Midget Airplane Races, Ft. Wayne, Ind.

Sept. 1-15—Sixth International Aeronautical Conference. Royal Aeronautical Society and Institute of the Aeronautical Sciences, Folkestone and London, England.

Sept. 2-8—1957 Flying Display, Society of British Aircraft Constructors, Farnborough, England.

Sept. 3-14—11th General Assembly, International Union of Geodesy and Geophysics, in conjunction with International Geophysical Year, University of Toronto, Canada.

Sept. 8-13—Second Annual Course on Investment Castings, Massachusetts Institute of Technology, Cambridge, Mass.

Sept. 9-13—Annual General Meeting, Inter-

(Continued on page 6)

AVIATION WEEK • JULY 22, 1957

Vol. 67, No. 3

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The information provided shows practical means to increase the validity, output and dimension of test data.
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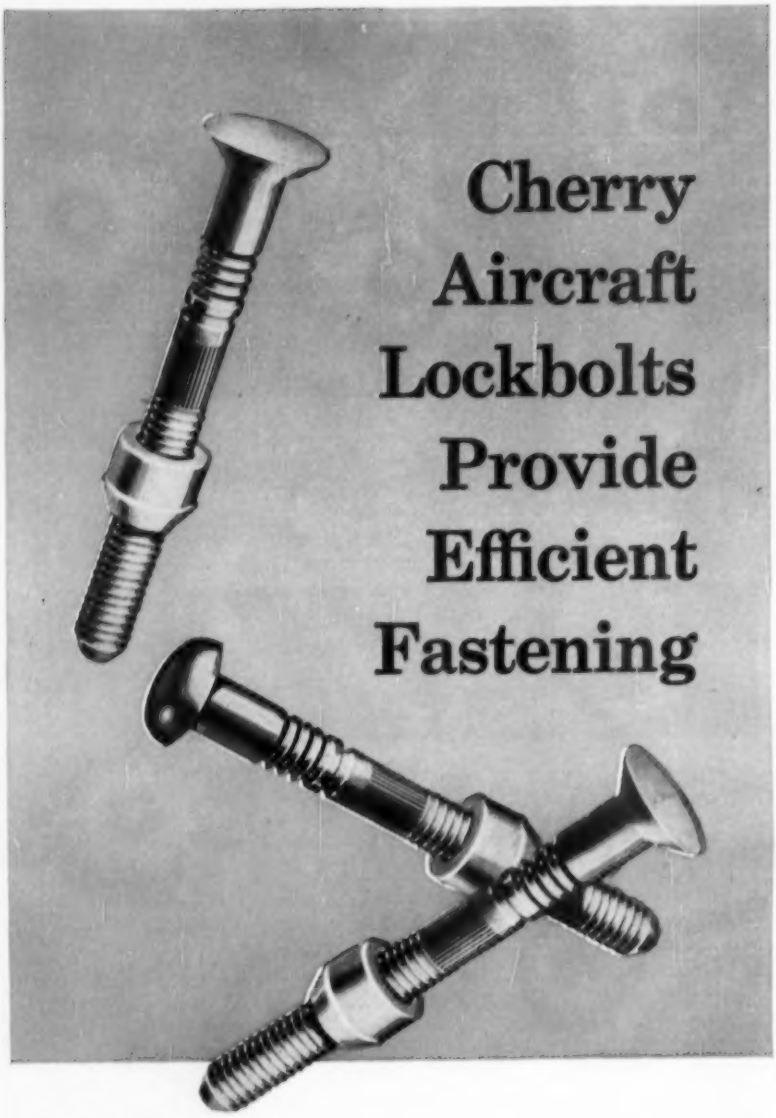

Cherry Aircraft Lockbolts Provide Efficient Fastening

Cherry Aircraft Lockbolts* save weight—give higher clinch than rivets—more uniform clinch than nuts and bolts—combine advantages of both—eliminate disadvantages.

Cherry Aircraft Lockbolts are designed and produced to meet specifications and requirements of the aircraft industry.

Cherry Aircraft Lockbolts are available from complete stocks in a wide range of diameters, grip lengths and head styles in alloy steel and aluminum alloy.

For data on Cherry Lockbolts, write for bulletin TCL-111 to Townsend Company, Cherry Rivet Division, P. O. Box 2157-N, Santa Ana, Calif.

*Licensed under Huck patents RE 22,792; 2,114,493; 2,527,307; 2,531,048; 2,531,049 and 2,754,703

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SANTA ANA, CALIFORNIA

Townsend Company

ESTABLISHED 1816 • NEW BRIGHTON, PA.

AVIATION CALENDAR

(Continued from page 5)

national Air Transport Assn., Madrid.

Sept. 9-13—Twelfth Annual Instrument-Automation Conference & Exhibit, Cleveland Auditorium, Cleveland, Ohio.

Sept. 13—Third Pacific Area National Meeting, American Society for Testing Materials, Sheraton-Palace Hotel, San Francisco, Calif.

Sept. 15—1957 Garden Party and Flying Display, Royal Aeronautical Society, Wisley Aerodrome, Weybridge, England.

Sept. 26-27—Fifth Michigan Aeronautics Conference, jointly sponsored by University of Michigan Transportation Institute, Western Michigan University, and The Aero Club of Michigan, Alpena, Mich.

Sept. 30-Oct. 5—National Aeronautic Meeting, Aircraft Production Forum & Aircraft Engineering Display, Society of Automotive Engineers, Hotel Ambassador, Los Angeles.

Oct. 2-4—Tenth Annual Meeting and Forum, National Business Aircraft Assn., Cosmopolitan Hotel, Denver, Colo.

Oct. 6-12—Eighth International Astronautical Congress, Barcelona, Spain; Registrar: Agrupacion Astronautica Espanola, Arda, Generalissimo Franco, 377, Barcelona.

Oct. 7-9—13th Annual National Electronics Conference, Chicago, Ill.

Oct. 7-10—Triennial Inspection, Lewis Flight Propulsion Laboratory, Cleveland.

Oct. 7-12—Eighth Annual Congress, International Astronautical Federation, Barcelona, Spain. For details write: IAF, 35 Lowell Rd., Concord, Mass.

Oct. 9-11—National Fall Convention, Society for Experimental Stress Analysis, El Cortes Hotel, San Diego, Calif.

Oct. 10-11—National Noise Abatement Symposium, Sherman Hotel, Chicago, Ill.

Oct. 21-22—Canadian Aeronautical Institute-Institute of the Aeronautical Sciences Meeting, Montreal, Canada.

Oct. 21-23—Conference on new developments in the field of power, American Society of Mechanical Engineers, Americus Hotel, Allentown, Pa.

Oct. 24-25—Fourteenth Annual Display, Aircraft Electrical Equipment, Aircraft Electrical Society, Pan Pacific Auditorium, Los Angeles, Calif.

Oct. 28-31—Second Winter Meeting, American Nuclear Society, Henry Hudson Hotel, N. Y.

Oct. 28-29—Third Annual Meeting, Association of the U. S. Army, Sheraton-Park Hotel, Washington, D. C.

Oct. 28-30—Annual East Coast Conference on Aeronautical and Navigational Electronics, Fifth Regiment Armory, Baltimore, Md.

Oct. 28-31—National Industrial Packaging & Handling Exposition, Atlantic City Convention Hall, N. J.

Nov. 5-7—Joint Military-Industry Guided Missile Reliability Symposium (limited to those with Secret security clearance), Naval Air Missile Test Center, Pt. Mugu, Calif.

Nov. 6-8—Third Annual Symposium on Aeronautical Communications, Hotel Utica, Utica, N. Y.

Nov. 18-29—International Air Transport Assn. Technical Conference, Miami, Fla.

To 30 g's without a whimper

CEC's DATATAPE FLIGHT RECORDER

First choice for data recording

When you need accurate reproduction of dynamic test data under severe environmental conditions, put a Consolidated DataTape Recorder on the job. This compact instrument will withstand without damage a force of 30 g's for 11 milliseconds along each of the three major axes. It will continue to perform to specifications under a vibrating force of 10 to 55 cps, 0.060" double amplitude, and will withstand steady accelerating forces up to 5 g's in any direction. In Air Force competition tests, the DataTape topped all others in an over-all evaluation. *For complete information, write today for your copy of Bulletin CEC 1561-X25.*

DATA CHANNELS... 12 or 24 standard, plus 1 flutter-control track and 1 time or voice track per 12 data channels.

TAPE SPEEDS... 7½, 10, 15, 20, 30, and 40 in/sec.

RECORDING TIME... 43 minutes at 10 in/sec; 57 minutes at 7½ in/sec.

FLUTTER... less than 0.15% peak-to-peak over 0-to-300-cps band @ 10 in/sec. At 30 in/sec, flutter from 0-to-300 cps will be less than 0.1%. Servo flutter compensation on playback reduces this figure still further; electronic system compensates for flutter at higher frequencies.

POWER... 115 volts, single-phase, 50/60/400 cps; 275 watts.

SIZE... 7 x 22 x 11¾"; 60 pounds.

CONTROLS, INDICATORS... all on top plate.

Consolidated Electrodynamics

300 North Sierra Madre Villa, Pasadena, California

OFFICES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

New Airborne capacitors and filters are

smaller, lighter . . .

aid miniaturization of electronic devices

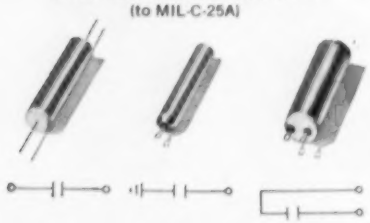
MINIATURIZED CAPACITORS

Utilizing Mylar dielectric and a special conductor, Airborne miniaturized capacitors offer microfarad ratings up to 12 times higher than those of ordinary capacitors of comparable size and weight. Vacuum impregnated and hermetically sealed in drawn steel cans or epoxy sleeves, they have excellent resistance to vibration, fungi, salt spray and humidity.

Airborne standard miniaturized capacitors are rated 200 v d-c and have an operating temperature range of —75°F to +300°F with only 12% capacitance change. At 300°F they withstand 150% rated voltage for 250 hrs. through a resistance of 1 ohm per volt.

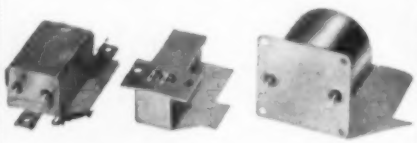
Where standard designs are not suitable, Airborne can produce special capacitors to meet your requirements. These custom miniatures likewise offer the advantage of reduced size and weight without sacrificing capacitance or dielectric strength. Typical is one of our new starting capacitors which is 75% lighter yet has twice the capacity and three times the dielectric strength of the old-style capacitor it replaced.

STANDARD CAPACITORS
(to MIL-C-25A)



Style "A" Style "B" Style "C"

TYPICAL SPECIAL CAPACITORS
(to JAN-C-25, MIL-1-6181B, MIL-M-8609)



E-8109 Style E-8104 Style E-8107 Style

Airborne Standard Miniaturized Capacitors—200 v d-c

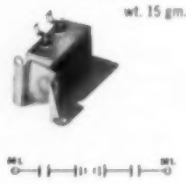
Microf. ±10%	Dia.	Length
.25	3/8	1-1/4
.5	1/2	1-1/4
1.0	5/8	1-1/4
3.0	7/8	1-1/8
4.0	1	1-1/8
5.0	1-5/32	1-1/8
6.0	1-1/4	1-1/8
7.0	1-5/16	1-1/8
8.0	1-29/64	1-1/8
9.0	1-1/2	1-1/8
.25	3/8	3/4
.4	1/2	3/4
.75	5/8	3/4
1.5	1	3/4
10.0	1-3/4	2-1/4

MINIATURIZED R.F. FILTERS

Airborne miniaturized r.f. filters also utilize Mylar dielectric and a special conducting material to reduce size and weight without compromising performance. Cores are molded to achieve maximum inductance with minimum bulk. Vacuum impregnated with polyamide resin; hermetically sealed in steel cans with glass terminals, Airborne miniaturized r.f. filters are serviceable from —75°F to +300°F. They meet JAN-C-25, MIL-1-6181B, and MIL-M-8609 and are available to your specifications. Typical standard constructions and circuits are shown at right, along with pertinent data on the motors to which these filters were matched. Mounting brackets are furnished to meet your requirements.

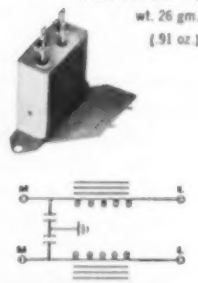
TYPICAL R.F. FILTERS

.94 x .50 x .81 in., wt. 15 gm.



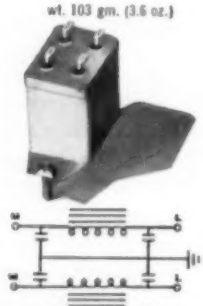
For 1.125 dia. split field series motor
No load current—.45 amp
Stall current—2.0 amp 100 v d-c
Comm-bar frequency—14 x 27900 rpm
Electro-graphitic brush

1.06 x .50 x 1.38 in., wt. 26 gm. (.91 oz.)



For 1.562 dia. split field series motor
No load current—2.8 amp
Stall current—18.5 amp
Comm-bar frequency—14 x 32000 rpm
Electro-graphitic brush

1.63 x 1.0 x 2.0 in., wt. 103 gm. (3.6 oz.)



For 2.2 dia. split field series motor
No load current—3.7 amp
Stall current—45 amp
Comm-bar frequency—14 x 18000 rpm
Electro-graphitic brush

Write for latest technical bulletin on Airborne miniaturized capacitors and filters

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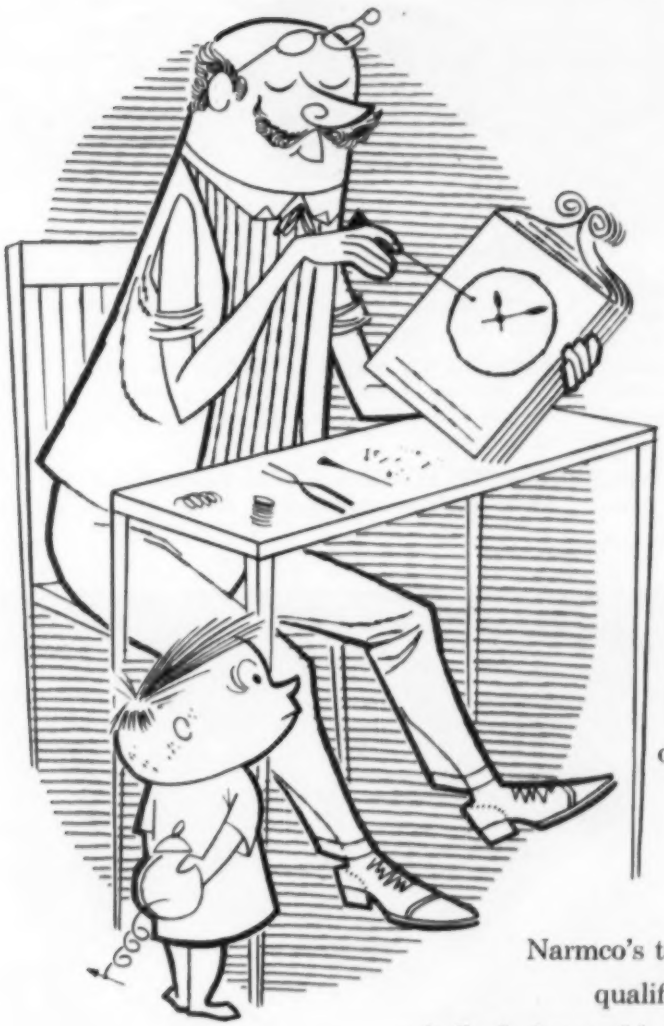
"NO SUBSTITUTE..."



To the airframe and missile manufacturer faced with budgets and tight production schedules, materials dependability is essential. In aircraft structural adhesives and laminating materials, Narmco... and its trade-names "Metlbond," "Conolon," and "Narmtape"... represent unquestioned dependability... the kind of dependability that's built upon years of accumulated experience.

Narmco know-how—from the trials of earliest pioneering work through a comprehensive knowledge of today's myriad applications of organic structural materials—effectively serves customers every day. There is, indeed, *no substitute* for such experience!

Narmco's team of youthful "oldtimers" is uniquely qualified to assist in solving your aircraft and missile design problems... and to assure you lighter, stronger, more heat resistant and more efficient structures fabricated with "Conolon" laminating materials and "Metlbond" and "Narmtape" structural adhesives... *challenging problems that metals alone cannot solve.*

NARMCO

PIONEERING THROUGH RESEARCH

Narmco technical field representatives throughout the United States and Canada can assist in solving your structural design problems quickly, efficiently and economically. For immediate assistance, write, wire or telephone

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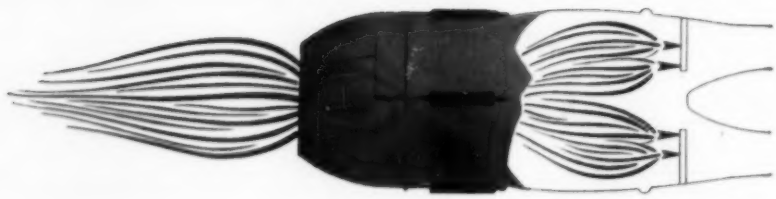
FIRE !



Starter! Pressurized! Fire!

And another J57 jet engine tunes up in one of our test cells. To look at that big monster belching flame with a rhythmic whine you'd think all production jobs on it were finished. After this testing, it should be merely a matter of a careful final inspection before shipping this jet engine.

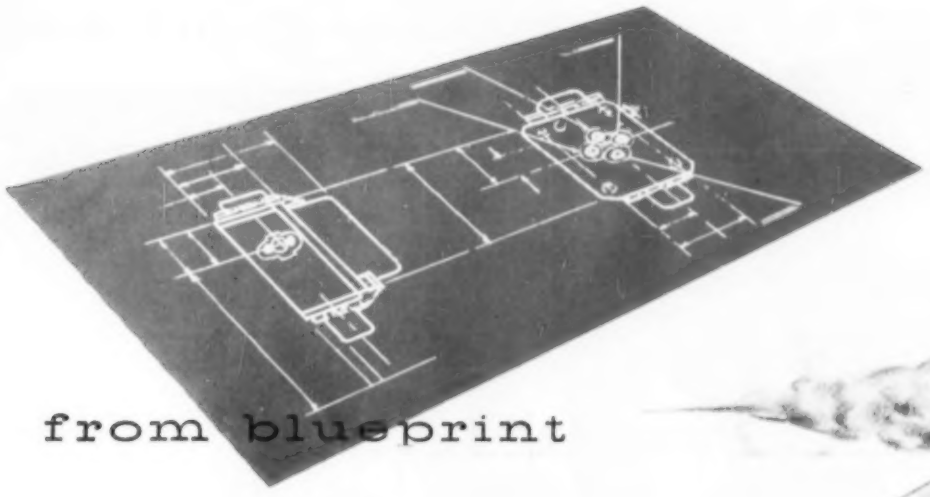
But *this* is where we start all over again. Every J57 engine is built, tested—*then torn down completely and inspected.* The engine is then rebuilt and given a final testing. Only at this point is it ready to be submitted for acceptance. This is the way these engines are built.

Admittedly this is a very careful process—but it's the way of making sure these Ford-built engines do everything expected of them, under all conditions.

These J57 jet engines *must* be dependable—a lot of people are depending on them.

AIRCRAFT ENGINE DIVISION • FORD MOTOR COMPANY

7401 SOUTH CICERO AVENUE • CHICAGO 29, ILLINOIS



from blueprint

to blue skies

From design concept to volume production, Moog's contribution to high performance electro-hydraulics has been unique. Originators of force-balanced nozzle-flapper* and of dry-motor servo valves*, Moog alone has been able to translate these concepts into full volume manufacture. The 40,000 units in the field verify a production record unmatched in the industry. Consult Moog if this kind of design-to-production performance is desired.

*Patented
Other Patents Pending

ELECTRO-HYDRAULIC SERVO MECHANISMS

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Research Laboratory, Paramus, New Jersey

Message from Melbourne

A recent short-wave broadcast from Melbourne, Australia . . . received in Syracuse, N. Y. (over 10,000 air miles) with no perceptible **flutter or fading** . . . is further proof that General Electric's new radio technique . . . Synchronous Amplitude Modulation*. . . is the solution to the problems of long-range radio operations. Its concept and operation are uniquely simple . . . SAM* is compatible with all present forms of radio equipment . . . its operators need no further specialized training . . . yet it preserves complex wave forms even while handling the Doppler effect. Its suppressed-carrier, double-sideband transmission and synchronous reception promise significant savings in weight and cost. Of paramount importance is SAM's* resistance to jamming and interference. Here again, is a vivid example of LMEE's invaluable contribution to progress . . . in furthering new uses for electronics.

For the very latest information on SAM* . . . write Section F

LMEE

Aviation Electronics Products Include:

WEAPONS CONTROL RADAR • SEARCH RADAR • INDICATORS AND DISPLAY • COUNTERMEASURES • NAVIGATION
MISSILE CONTROL • AIRBORNE SONAR • COMMUNICATIONS • FUZES • AUTOMATIC TEST • DATA PROCESSING

Progress Is Our Most Important Product

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LIGHT MILITARY ELECTRONIC EQUIPMENT DEPARTMENT
FRENCH ROAD, UTICA, NEW YORK

RESEARCH AND DEVELOPMENT

At Temco GROWTH tells the story

Growth — in expenditures for research and development, for example — tells the Temco success story.

Temco's investment in research and development in the last year increased more than 500% over the substantial sum spent in 1954! This tremendous growth in developmental efforts is part of a long-range program to establish Temco firmly in the electronics and missile weapons system field.

The investment is paying off handsomely. Temco was awarded prime contracts for three of its own missile and aircraft designs last year. Operations research studies continue in other areas, particularly the nuclear field.

Temco's research and development plans continue to expand. This growth is providing experienced engineers an unequalled opportunity in electronics, guidance systems, jet aircraft, missiles and weapons systems.

MR. JOE RUSSELL, Engineering Personnel
Room 103-K, Temco Aircraft Corp., Dallas, Texas

Please send me complete details of the Temco story of unusual opportunities for experienced engineers. I am especially interested in_____

NAME_____

ADDRESS_____

CITY_____ STATE_____

TEMCO
AIRCRAFT CORPORATION • *Dallas, Texas*

II

This is the second of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.

Effects of Elements Used in Alloy Steels

To simplify a rather complex subject, let's outline some of the individual effects of four leading alloying elements used in alloy steels:

NICKEL—One of the fundamental alloying elements, nickel provides such properties as deep hardening, improved toughness at low temperatures, low distortion in quenching certain types of tool steels, good resistance to corrosion when used in conjunction with chromium in stainless grades, and ready response to economical methods of heat-treating.

CHROMIUM—This element is used extensively to increase the corrosion-resistance of steel. It also improves the surface resistance to abrasion and wear. It exerts a toughening effect and increases the hardenability.

MOLYBDENUM—This element exerts a strong effect on the hardenability and toughness of steel. It greatly increases strength at high temperatures as well as the creep-strength of steel.

VANADIUM—An element used to refine the grain and enhance the mechanical properties of steel.

A combination of two or more of the above alloying elements usually imparts some of the characteristic properties of each. For example, chromium-nickel grades of steel develop good hardening properties with excellent ductility. And chromium-molybdenum steels develop excellent hardenability with satisfactory ductility and a certain amount of heat-resistance. In other words, the total effect of a combination of alloying elements is usually greater than the sum of their individual effects. This interrelation must be taken into account whenever a change in a specified analysis is evaluated.

Bethlehem metallurgists can be of considerable help to you in selecting the proper alloy steel for any use. These men will gladly give unbiased advice on alloy steel analysis, heat-treatment, machinability, and expected results. Feel free to call upon them at any time.

And please remember, too, that Bethlehem manufactures all AISI standard alloy steels, as well as special-analysis steels and the full range of carbon grades. You can rely upon their quality, always.

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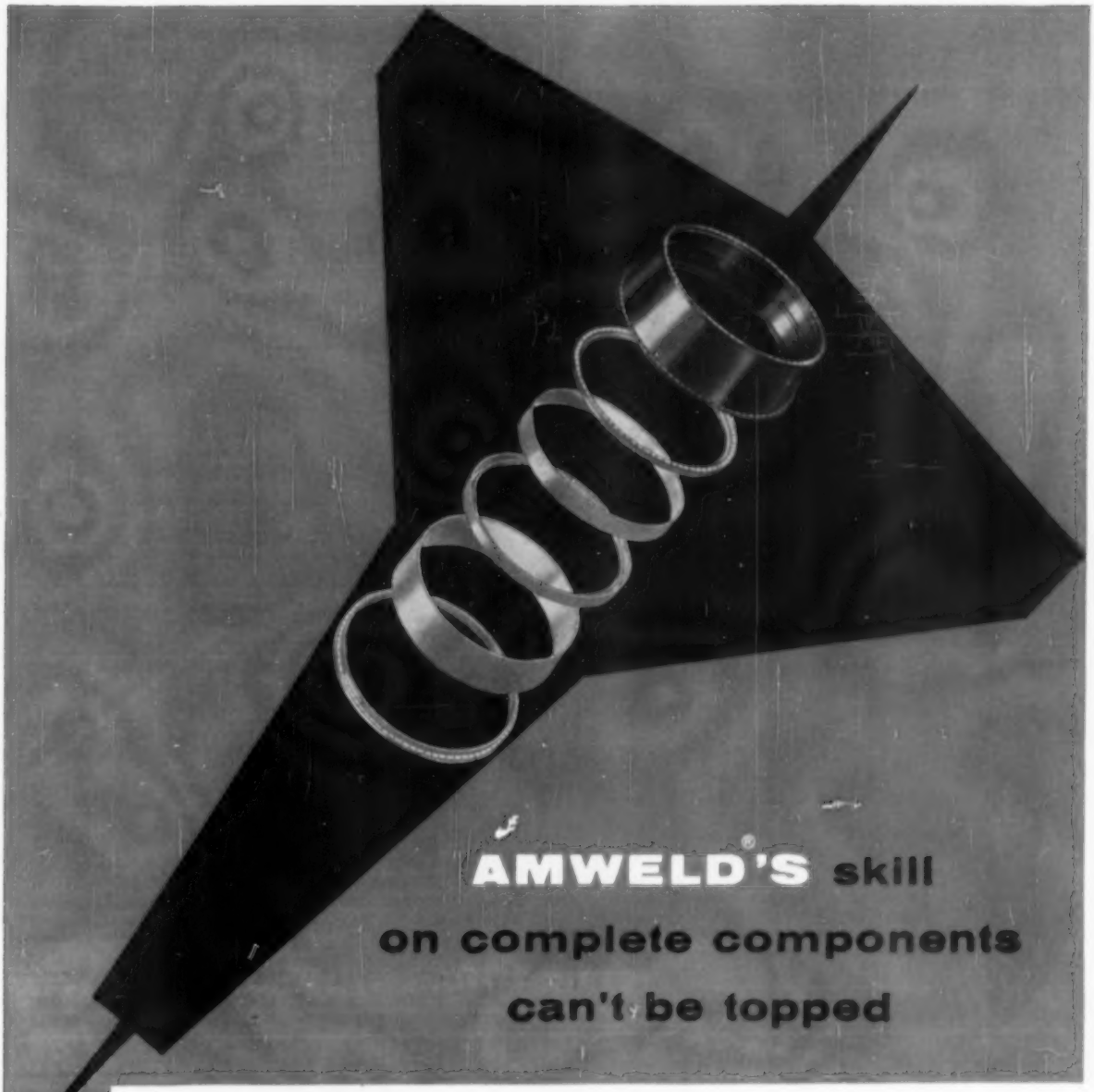

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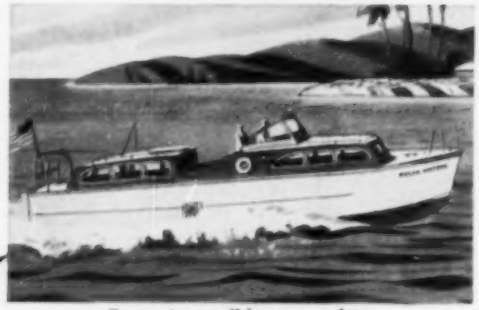

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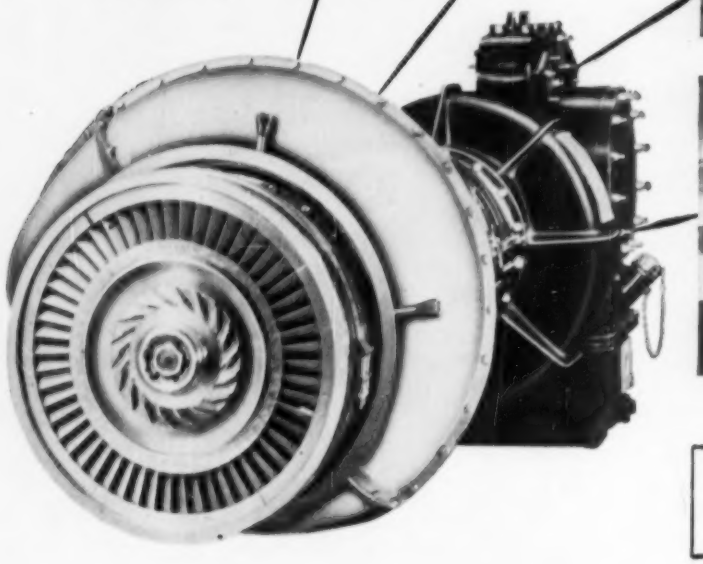

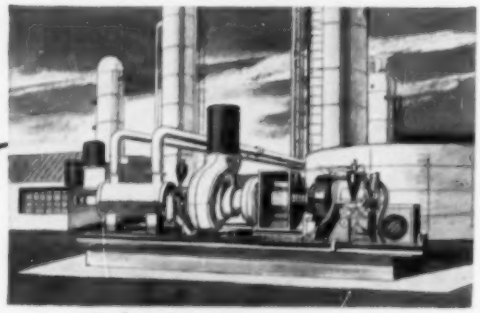

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COVER: Paths of Air Force B-47 and practice bomb are etched by smoke trails during low-altitude loft-bombing maneuver in which bomb is released at preselected point during an Immelmann turn. For details of new Lear LABS bombing system, see page 62.

Picture Credits:
107—Sovfoto; 102, 115—Russell Melchor.

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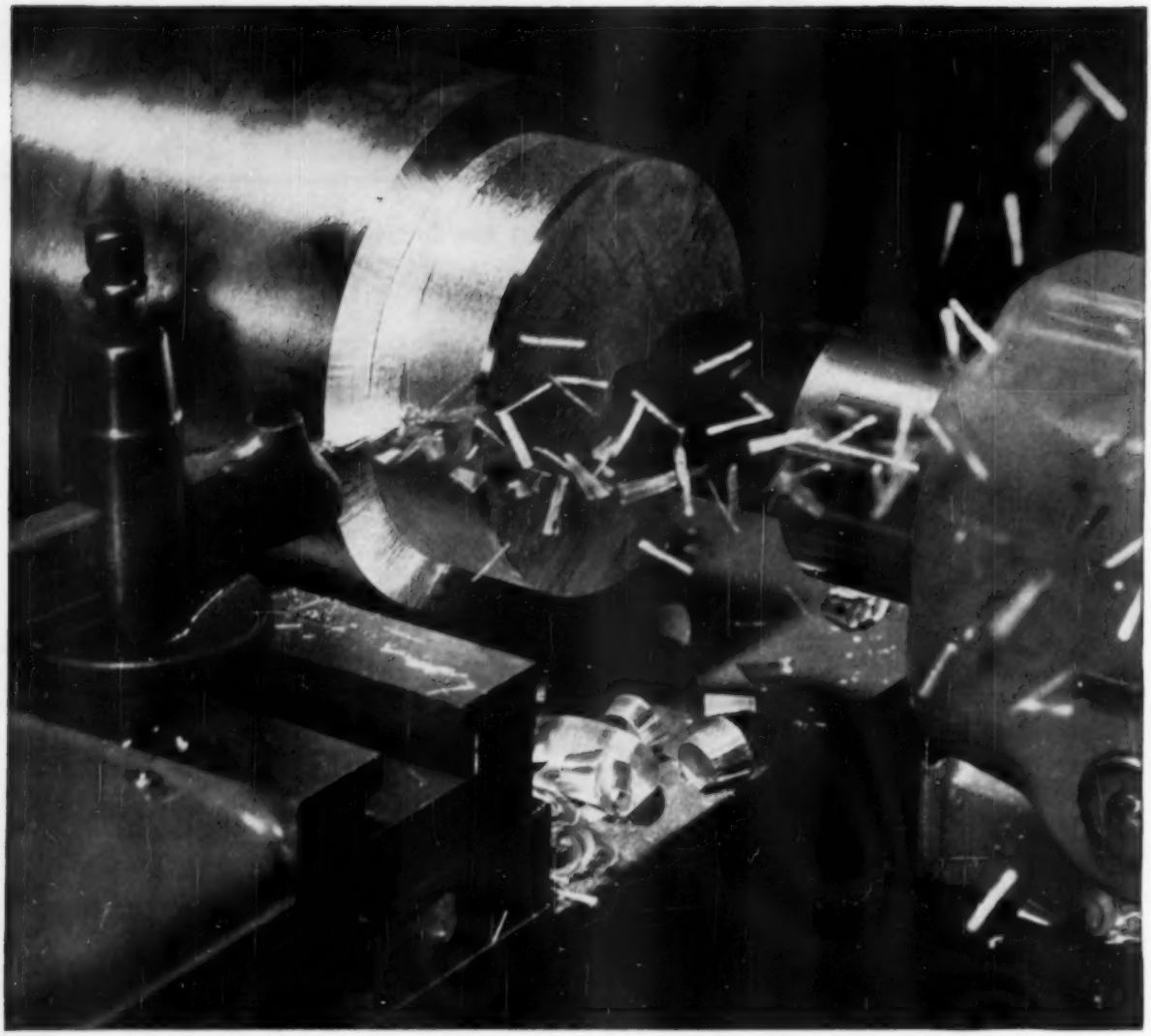


Speed! Of all structural metals, Magnesium costs less to machine

In the picture above, a lathe is making a roughing cut of 0.800" in an eight inch magnesium billet. The feed is 0.030 inches per revolution at a speed of 630 feet per minute. In finishing operations, cuts of 0.500" can be made with a feed of 0.003 ipr and a speed of 5,000 fpm.

That's real speed and efficiency—the kind you can always expect when you machine magnesium. This remarkable metal can be milled, drilled, sawed, reamed, bored, planed, tapped and threaded faster than any other structural metal!

Faster machining means easier machining and lower cost machining. It means more production per hour and per dollar, and longer tool life.

The following table shows how well magnesium compares to the others:

METAL	RELATIVE MACHINABILITY
magnesium	1.0
cast aluminum	1.8
brass	2.3
cast iron	3.5
rolled aluminum	5.0
mild steel	6.5

Let us give you more information about the machinability of magnesium. Contact the nearest Dow sales office or write to THE DOW CHEMICAL COMPANY, Magnesium Department, Midland, Michigan, Dept. MA 1404A.

YOU CAN DEPEND ON DOW

EDITORIAL

Soviet Jet Transport Progress

Public display of the new Soviet gas turbine powered transport prototypes at Vnukovo Airport reported in detail on page 27 provides another good yardstick by which to measure Russian aeronautical progress. The appearance of these new jet transport types should come as no surprise to AVIATION WEEK's readers. Plans for this family of jet transports were published in AVIATION WEEK just about a year ago after they were revealed to us in Moscow by top officials of Aeroflot and the Soviet aircraft industry. It is interesting to note that except for the substitution of the four engined Ukrania for the twin engined Antonov turboprop transport then flying, the new planes match closely the plans discussed with us more than a year ago.

From the first rough details available on the four new transports and the fifth due to appear next fall they embody no startling technical advances and fall well within the generally known state of the art. Perhaps the two outstanding features are their powerplants, with both the Lulko turbojets and Kusnetzov turboprops a cut above anything flying commercially elsewhere; and the marked trend toward high density seating evidence in all of the new models. Foreign passengers on Aeroflot's current fleet of Il-12 and Il-14 piston powered transports have been impressed by the relatively low density passenger capacity and the lack of strict weight control on cabin furnishings. We recall an Il-12 flight from Copenhagen to Moscow where the substitution of conventional Western airline lavatory facilities and a weight reduction in the husky stewardess could have provided capacity for another trio of paying passengers. Even the initial versions of the Tu-104 jet transport still had some interior furnishings more in tune with circa 1900 Pullman parlor cars than a modern jet transport. In the new planes foam rubber, lightweight plastics and metals long familiar on Western transports have been substituted for cast iron lavatories and mohair upholstery. With passenger capacities of 75 to 100 the new transports are all pointed toward a favorable revenue-operating cost ratio. It is also interesting to note that the Soviets, like the British, re-affirm their faith in the turboprop engine as an economical transport powerplant.

The Soviets are justifiably proud over this new family of jet transports. Their official organs such as Pravda and Sovietskaya Aviatsiya, newspaper of the Red Air Force, are telling the Russian people that they are now two to three years ahead of foreign competition in the jet transport era. At the moment it looks as though the Soviets have an opportunity to get into significant scale of jet transport operations perhaps a year to 18 months before either United States or French jet transports see widespread service. Of course the British with the turboprop Viscount and Britannia are already operating on five continents.

Technical superiority in any phase of aviation is at best an ephemeral matter. It will be interesting to see how the new family of prototypes progresses into production and operational service. Aeroflot's efforts in working the initial operational "bugs" out of the Tu-104 indicate they are no novices at this problem and have the capability to handle it in reasonable time. But putting five new types of gas turbine powered transports into large scale operations would provide formidable tasks for any airline in the world today and Aeroflot will certainly have its hands full converting from the piston engine Ilyushins to the new jets on a fleet-wide scale.

Another acid test will come when the new Soviet jets compete with Western gas turbine powered transports in the international market. Aeroflot officials made it quite clear in talking to us a year ago that when the proper jet equipment was available they were determined to compete for international traffic even beyond the limits of the Soviet satellites. The Tu-110 with its 2,000 mile range can provide nonstop service from Moscow to virtually all European capitals and the turboprop Ilyushin 18 can range even farther.

Nikita Khrushchev has repeatedly emphasized the Soviet Union's determination to compete economically with the Western nations and the airline business will certainly soon provide a focal point for that competition. Whatever the outcome it is now evident that the Soviets are serious in their entry into the international airline business and have fielded a full family of jet transports.

It is also extremely significant that the Soviets have the determination and resources to bring through a rather large jet transport development program at the same time that they are pushing hard on supersonic fighters, new long range jet bombers and a medium and long range ballistic missile program.

New Crusader Record

The Navy, Marine Corps and Chance Vought Aircraft Corp. can be extremely proud of the performance of the F8U-1P Crusader and its pilot, Marine Maj. John Glenn, in setting a new transcontinental speed record of 3 hr. 23 min., shaving about 21 minutes from the previous record set by USAF Lt. Col. Robert Scott in a Republic F-84F Thunderjet. The photo-reconnaissance version of the Crusader incorporating new area rule applications averaged Mach 1.1 for the transcontinental trip and flew most of the way at 50,000 ft. In addition to providing another demonstration of Crusader's operational capability the speed record run also demonstrated startling performance of the Pratt & Whitney J57 turbojet and its afterburner by continuous use of the engine with full afterburner power for the entire flight, except refueling, from take-off to deceleration for landing. The Crusader already holds the Thompson Trophy 1,015 mph. speed record. Without letting any official cats out of the bag we can safely predict that more top aviation honors are in store for the Crusader, which is the first fighter in the 1,000 mph. class to go into operational service on aircraft carriers. The Navy's Bureau of Aeronautics, which made the decision to buy the Crusader, and the Chance Vought engineering-production team that created it as an operational weapon have done this country a great service.

—Robert Hotz

THERMOCOUPLES TAKE JET'S TEMPERATURE

Fenwal Harness Is Foolproof, Has Long Life

ASHLAND, MASS. — One mechanic who'd never seen Fenwal's Jet Engine Harness before installed it properly in fifteen minutes.

A fool would need a few minutes more to do the trick, but he'd have to be an idiot to get it on wrong. Fenwal makes the harness, which senses a jet's exhaust temperature with thermocouples, as simple as it can possibly be. It can be used for indication, control, or, with certain inexpensive modifications, for both.

The service-life of the harness is at least hundreds of hours in excess of Government specifications. The actual life can only be given as more than a thousand hours, since field tests were called off at that point, with absolutely no signs of failure apparent.

Fenwal pre-forms the harness to fit your engine, and the installer simply slips it around the tail cone. Only two bolts for each thermocouple lock the thermocouple to the harness and the harness to the mounting boss. All thermocouples are keyed, so that they can be installed only in the proper way.

Terminal studs have been eliminated — and vibration-induced breakage and short circuiting have been eliminated too. In place of studs are curved buttons on the thermocouples and flat buttons on the harness. These buttons make the contact between the thermocouple and the harness.

As for maintenance, nothing could be simpler. If it ever becomes necessary to replace a thermocouple, only two bolts are involved. Since the contact buttons are exposed to air flow, removal of moisture and foreign particles from them is virtually automatic. The harness itself needs no care, since it is sheathed in stainless steel, and the bus bars are insulated with a special hard asbestos.

RELIABLE AND FOOLPROOF — This Fenwal Jet Engine Harness senses jet engine temperatures with interchangeable thermocouples for indication and control purposes. It is exceedingly simple to install. It has been service tested for 1000 hours without failures.

You don't have to worry about the effects of differential expansion on the harness, either. The assembly is semi-flexible, and puts only light stresses on the bosses. The bosses don't have to be "beefed up."

The system performs at ambient temperatures up to 1200°F, and Fenwal is prepared to make systems for higher temperatures on request.

It is remarkably light. A four-thermocouple system with a 21-inch diameter harness, for instance, weighs only 3.6 pounds, bolts and all.

You will have no trouble integrating the system with your own indicator or control schemes, or both. The circuitry is simple, too, with balancing resistors in the thermocouple mounting pads for maximum control accuracy. Tolerances are such that no adjustments are needed when a thermocouple is replaced.

Contact your local Fenwal Sales Engineer, or write to Fenwal direct to learn how this system and other widely useful Fenwal concepts can solve temperature control problems now facing you. **Fenwal Incorporated, Aviation Products Division, 129 Pleasant Street, Ashland, Mass.**

Fenwal

CONTROLS TEMPERATURE ...PRECISELY

WHO'S WHERE

In the Front Office

Lewis C. Burwell, Jr., board chairman, Overseas National Airways.

T. R. Gamble, a director, Northwest Airlines, Inc.

M. Wilfred Rice, a director, Resistoflex Corp., Roseland, N. J.

Glen McDaniel, a director, Litton Industries, Beverly Hills, Calif.

A. C. Rubel, a director, Northrop Aircraft, Inc., Hawthorne, Calif.

Roland Whitehurst, president, Jessall Plastics, Inc., (Kensington, Conn.) subsidiary of the Electric Storage Battery Co., Philadelphia, Pa. **Monroe G. Smith** succeeds Mr. Whitehurst as general manager of Exide Industrial Division, Electric Storage Battery Co. Also: **William C. Leingang**, general manager, Stokes Molded Products Division (Trenton, N. J.) of Electric Storage Battery Co.

Walter Sternberg, a senior vice president, National Airlines, Inc.

Douglass F. Johnson, executive vice president, Transocean Air Lines.

Joseph W. Antonides, vice president-solid propellant operations, Reaction Motors, Inc., Denville, N. J.

R. K. Hoffman, a vice president, Acme Precision Products, Inc., Dayton, Ohio.

Brig. Gen. Vincent J. Meloy (USAF, ret.), special assistant to the president, United Aircraft Service Corp., Hamilton Standard Division, St. Petersburg, Fla.

Rear Adm. John B. Pearson, Jr., (USN, ret.), director of development planning, North American Aviation, Inc., Los Angeles, Calif.

Frederick H. Lee, Jr. is establishing a Government-Aviation Division for Franklin Research Co., Philadelphia, Pa.

Rear Adm. H. W. Seely (USN, ret.), Washington, D. C. field service engineering representative, Texas Instruments, Inc., Dallas, Tex.

Honors and Elections

William L. Worthen, president of Bone Engineering Corp., has been elected president and board chairman of Strategic Industries Association. Mr. Worthen succeeds **Leo A. Pfankuch**, executive vice president of Pacific Scientific Corp.

Changes

W. W. Fox, special assistant on the F-102 and F-106 programs, Convair, division of General Dynamics Corp., San Diego, Calif.

John H. Baker, manager of marketing, jet engine department, Aircraft Gas Turbine Division, General Electric Co., Cincinnati, Ohio.

David J. Caple, sales engineering manager, Orenda Engines Limited, Malton, Ontario, Canada.

Dr. W. H. Brandt, director-advanced systems engineering, Sunnyvale Manufacturing Division, Westinghouse Electric Corp., Pittsburgh, Pa.

(*Continued on page* 124)

INDUSTRY OBSERVER

► Infrared proximity warning system (PWI), which is expected to weigh only 50 lb. installed, will be revealed by Aerojet-General this week at Air Transport Assn. meeting in Los Angeles. Aerojet says it hopes to flight test a production prototype within six months. Raytheon may also reveal plans to develop an infrared proximity warning system at the meeting, and Radio Corp. of America is expected to report on possibilities of using existing weather radars for proximity warning.

► **Fifty different versions of pods for Convair's B-58 have been studied thus far. Included in the list—mainly restricted to missile configurations—is the possibility that a powerplant may be carried in the pod to increase the aircraft's maximum speed, now in the vicinity of Mach 2 (AW July 15, p. 28). Powerplant could be turbojet, ramjet or rocket. If range is a primary factor, pod could carry fuel. Current pod configuration includes both fuel and bomb space. Pods also can carry reconnaissance cameras and electronic countermeasures.**

► Engineering details for the operational Douglas Thor intermediate range ballistic missile are not yet finalized. Work on mockups of the missile is now getting underway to provide for realistic training in maintenance and checkout.

► **Radioplane air-to-surface Crossbow missile now under evaluation at USAF's Holloman AFB probably won't be brought beyond the development stage because of lack of financial support. Missile is subsonic with a speed of approximately 500 kt. Powerplant is a turbojet engine.**

► Convair F-102 interceptor now has fittings for external fuel tanks as standard equipment. External tanks will be slung under the wings for long-range ferry missions.

► **Gyrodyne Corp. of America, St. James, Long Island, N. Y., has built three one-man XRON-1 rotorcycle helicopters, now has two more under construction. Aircraft are undergoing military qualification tests prior to delivery to the Navy for final test program. Gyrodyne plans to install a 60 hp., four-cycle McCulloch target drone engine in XRON-1 for evaluation. Ships three, four and five will be adaptable to either the McCulloch 60 hp. or four-cycle Porsche engine. Gyrodyne has given contract to Porsche of Stuttgart, Germany, to develop a 62 hp. powerplant with modifications aimed at improving the cooling and making it more suitable for vertical installation. Porsche engine used in XRON-1 tests proved to be an exceptionally reliable, maintenance-free powerplant.**

► Douglas A4D-2 midget attack-bomber has been flown with a maximum gross weight of more than 22,000 lb. Empty weight of aircraft is 8,300 lb.; normal gross weight, about 15,500 lb.

► **Convair is building approximately 35% of its F-106 high-speed, all-weather interceptor at its Ft. Worth Division plant.**

► Temco plans to roll out first production model of its TT-1 trainer late in August for Sept. 1 delivery. Navy has ordered 14 of the trainers, now officially designated the Pinto.

► **Defense Department may ease cancellation of the Navaho intercontinental cruise missile (AW July 15, p. 29) by awarding North American Aviation Inc. a contract for a B-52 missile pod similar to the ones planned for the Convair B-58.**

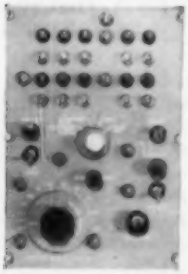
► Watch for Curtiss-Wright to make a serious bid to get into the solid propellant rocket engine business. Until now, the company has concentrated on liquid rocket engines.

ASW EQUIPMENT
BY STRATOS

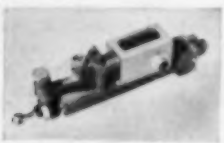
- Sonobuoy Launchers
- Retro Ejectors
- Actuators
- Control Panels
- Complete Systems

Retro Marine Marker Ejector System, Control Box, 3000 psi Compressor, Solenoid Valve, High Pressure Storage Bottle.

Sonobuoy ejector using "Pogo Stick" Free Piston Actuator principle.



Master Control Panel to control complete ASW stores ejection system.



Pneumatic Actuator for opening skin door.

Stratos builds a variety of equipment and complete pneumatic systems for sub-hunting patrol aircraft. Included are:

Free Piston Pneumatic Store Ejectors—using the patented "Pogo Stick" principle to hurl delicate sonobuoys clear of the aircraft without endangering delicate components:

Complete ejection systems to plant flares and markers with pinpoint accuracy, using an air gun to "shoot" stores rearward at a speed which cancels out the aircraft's forward motion; and,

Associated equipment such as skin door actuators, compressors, valves and integrated control systems.

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Washington Roundup

Hebert Charges Coercion

As a House subcommittee began public hearings last week on aircraft engine manufacturers' profits and procurement policies, Chairman F. Edward Hebert (D.-La.) charged that Defense Department had "coerced" Air Force into helping "bail out" the Studebaker-Packard Corp. by switching contract overhaul of J47 engines from General Electric Co. to Studebaker-Packard.

The Studebaker-Packard plant is being operated by Curtiss-Wright Corp. (AW Aug. 13, p. 26), first company called before Hebert's Armed Services Investigating Subcommittee. Hebert said he "completely absolves" Air Force in the J47 case. "They resisted the move," he said. "General Electric was doing a magnificent job," Hebert said. "It was simply a case of the government bailing out big business—the Studebaker-Packard Corp."

Hebert said he will prove in the course of the hearings that the "bail out" attempt, involving the J47 and other defense contracts cost the taxpayers $25 million.

Lead-off witness Roy T. Hurley, chairman and president of Curtiss-Wright Corp., told the House Armed Services Investigating Subcommittee that taxes should not be considered as part of profit but as part of the cost of doing business. Hurley also urged elimination of some redetermination and renegotiation procedures with regard to profits on government contracts and suggested modification of procurement regulations. Services should be given more freedom of action in the use of appropriated funds, he said, but they should be "held accountable for the end result of such use."

Hurley charged that "in the world of business and government today, too much emphasis is being placed on profits and not enough on cost reduction. . . . Too often in dealing with price redetermination and price renegotiation . . . we have been faced with what amounts to nothing more than profit cutting."

Hurley also warned that "we are now returning to the position of having 7% of military engine capacity in one company. Some day when an emergency again occurs, we will be unable to supply the engines needed and the engines will lack the progress that is the natural result of competition."

Curtis Airways' Advisor

Edward P. Curtis, who recently resigned as special presidential assistant in charge of the Aviation Facilities Planning Group (AW June 17, p. 5), has been retained for an indefinite period of time as a consultant to the group now headed by Elwood Quesada. Curtis has returned to his former position as vice president of the Eastman Kodak Company in Rochester, N. Y. but will remain on call to assist in the development of the airways and navigation program he formulated under presidential authorization during the past 18 months.

Civil Aviation Bills

Strong support for legislation aimed at restraining State Department's award of air rights to foreign carriers has developed on Capitol Hill (AW July 15, p. 25). Eight members of the Senate Commerce Committee have joined in sponsoring the measure introduced by Sen. Warren Magnuson (D.-Wash.), chairman of the committee, and Sen. John Bricker (R.-Ohio), ranking minority member. These are: Sen. John Pastore (D.-R. I.), Sen. George Smathers (D.-Fla.), Sen. Strom Thurmond (D.-S. C.), Sen. Andrew Schoeppel (R.-Kans.), Sen. John Butler (R.-Ind.), Sen. Charles Potter (R.-Mich.), Sen. Frederick Payne (R.-Mo.) and Sen. Norris Cotton (R.-N. H.). Rep. Oren Harris (D.-Ark.), chairman of the House Commerce Committee, has introduced the measure on the House side.

Other civil aviation developments on Capitol Hill are:

• **House passage of legislation** directing Civil Aeronautics Board to grant permanent certificates to U. S.-Alaska carriers appears to assure final enactment. The Senate approved the measure last year. Carriers affected: Alaska Airlines, Pacific Northern Airlines and Northwest Airlines.

Belgium Bilateral

Meanwhile, airlines are expressing fears that negotiations for a new air transport agreement with Belgium which began last week will result in Sabena, the Belgium airline, receiving additional rights to the U.S. travel market. According to the Air Transport Assn., the Belgium government wants rights from Belgium to Montreal, to San Francisco and beyond, and either from Belgium to New York, to Mexico City and beyond to South America or from Belgium to Miami, to Mexico City. Sabena now flies from Brussels to New York, while the U.S. has rights to fly to Brussels and beyond to Leopoldville in the Belgian Congo and beyond.

U.S. carriers are satisfied with the current agreement with Belgium, which they say gives Belgium a greater potential than the U.S. carriers receive in return.

Two other air agreements concluded by the State Department this year prompted bitter criticism from the industry, which airlines say give away far more rights than are received in return. The two agreements are the Dutch and Australian bilaterals.

Speed Records

Defense Department is softening its attitude on speed-runs by operational military aircraft. Requirement that planes be operational for at least a year before making any attempt on records has been cut to six months, and Air Force apparently will get the next crack at the Thomson Trophy, now held by Navy's F8U Crusader at 1,015 mph. It would use the McDonnell F-101A, probably in late fall or early winter. F-101A also is the only aircraft that will meet the six months' operational requirement for any attempt on the transcontinental speed record in the near future. Navy took this one away from Air Force last week (see page 30). Earlier objections on speed record attempts were based on theory that runs revealed information on operational capability of aircraft.

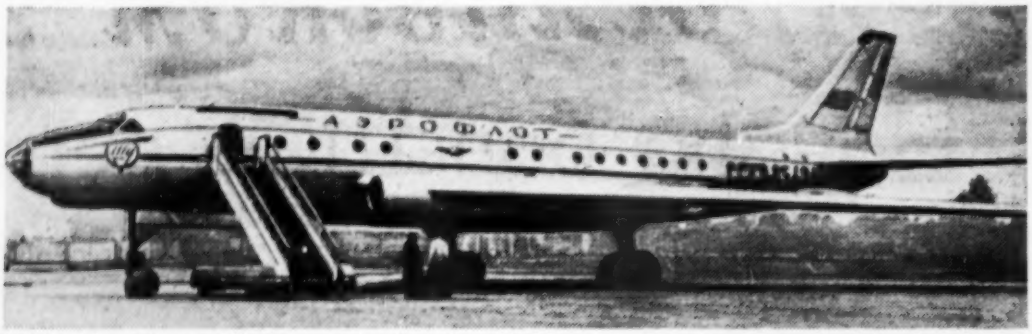
Capital Gains

Witnesses rushed through testimony on the Capital Gains and Government Guaranteed Loan Bills last week during hearings before the House Commerce Committee.

The Senate Commerce Committee already has held hearings on the Guaranteed Loan Bill but has not yet acted on the Capital Gains Bill. The two are designed to give financial aid to local and territorial airlines to enable the airlines to obtain more modern equipment (AW July 1, p. 43). Hearings on a third bill, the Equipment Trust Bill, were held earlier by the House Judiciary Committee.

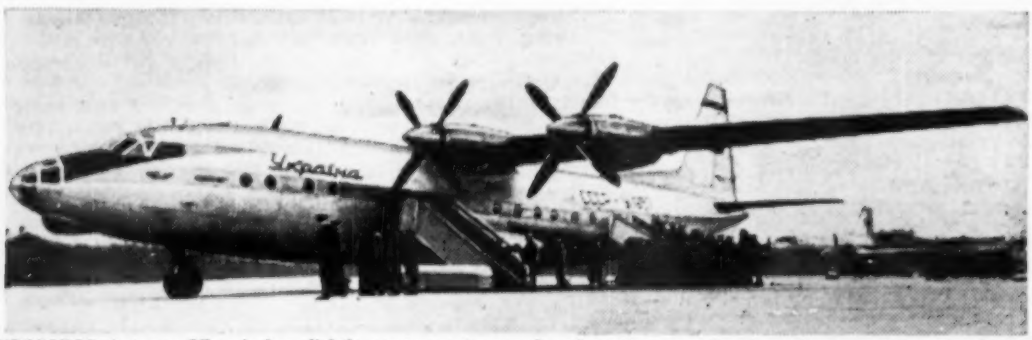
—Washington staff

TUPOLEV 110 four jet transport, on display in Moscow. It bears a family resemblance to the twin-engined Tu-104, first Russian turbojet transport, but is bigger. It has a passenger capacity of 100 compared to 50 for the older aircraft. The engines appear to be the same Lulko design which powers the Tu-104, the Bison, and the Badger. Thrust of the civil version is reported to be about 14,500 lb. Douglas DC-8 and Bocing 707 transports are to carry up to 180 passengers with similar amount of power.



TU-104A (above) is essentially the same aircraft as the original Tu-104 except for an increase in seating from 50 to 70 passengers. Similarity between the Tu-104 and Tu-110 empennages, nose sections, and engine installations is obvious in the two photos. Tu-104A compares roughly to the Comet 4 in seating capacity and speed, but has 10,000 lb. less thrust.

NEW TURBOPROP Ilyushin-18 Moscow bears close resemblance to Douglas designs. In performance and seating capacity it parallels the Lockheed Electra. The Moscow carries up to 100 passengers at 400 mph. cruise speed. Its Kusnetzov 4,000 eshp. engines have about the same power as the Allison 501 turboprop in the Lockheed aircraft.



TURBOPROP Antonov Ukrania has slightly greater cruise speed and seating capacity than the new 800 series Vickers Viscount. It would seem however that the Ukrania would have much more growth potential because it is powered by 4,000 eshp. engines while the Viscounts have less than 2,000 eshp. Ukrania has landing gear installation similar to C-133, and other new U. S. transports and is described by Russian officials as having good rough field performance.

Soviets Display New Turbine Transports

USSR moves nearer emergence as major competitor; shows four new turbine planes, says fifth is on way.

By Robert Hotz

Soviet Union moved another step toward its goal of emerging as a major competitor for international air traffic last week with the public display of four new gas turbine powered transports at Vnukovo Airport near Moscow and announcement that a fifth would be flying before October. The new family of jet transports correspond in almost every detail to the plans revealed to AVIATION WEEK in Moscow a year ago by top Aeroflot and Soviet aviation industry officials (AW July 2, 1956, p. 26; July 9, p. 26; July 30, p. 23).

Il-18

New Russian jet transports are:

• **Ilyushin-18.** This transport named the Moscow is a low wing monoplane powered by 4,000 eshp. turboprop engines. It has a passenger capacity ranging from 75 to 100 in first class or tourist configurations; a cruising speed of 400 mph. and a nonstop range with full payload of 2,600 miles, equivalent to the Moscow-Delhi stage length. The airframe design is officially credited to Serge Ilyushin, creator of the Il-12 and Il-14 twin engine, piston powered transports that are now the main Aeroflot workhorses. Powerplants are credited to Kusnetzov, who is billed in official Soviet publications as the father of Russian turboprop development. All official Soviet sources use the designation Ilyushin-18 for the Moscow despite earlier use of the same designation for a four engine, piston powered transport that never got much beyond prototype stage. The Moscow prototype was built in Soviet Aircraft Plant No. 30 located on the edge of Central Airport inside the Moscow city limits. This plant has been devoted primarily to Il-14 production.

The Moscow appears to be designed solely as a commercial transport in contrast to the marked military look that characterizes the Tupolev and Antonov transport designs. Externally, the Moscow looks like a Douglas DC-6 fitted with turboprop engines. The engines are mounted on the upper surface of the wing with tailpipe exhausting on top of the trailing edge and are geared to a four-blade propeller. Propellers have streamlined conical spinners to lower drag and ease airflow into the engine intakes. Oil coolers are mounted below each engine.

Fore and aft loading doors of the Moscow sit high off the ground and require special ramps and stairs about as high as those now used for DC-6s and Constellations. Wing and tail are not swept. Cabin has 15 round windows on each side and utilizes a three and two abreast seating combination for the 75 passenger configuration. Middle seat in the three row side is staggered slightly to the rear of the inner and outer seats to permit more comfort and better egress. Streamlined radar housing is installed in the nose in contrast to the bulging chin type military radar installations in the Tupolev and Antonov transports.

Main landing gear uses four wheel bogies and retracts into the inboard engine nacelles.

Double wheel nose gear retracts into the fuselage. Serial number of the prototype Moscow displayed at Vnukovo was 115811.

Tu-110

• **Tupolev 110.** This new transport powered by four turbojet engines is designed to carry 100 passengers in the Tu-110A tourist version and 50 in a special first class deluxe service. Although designated officially as a Tupolev design, considerable credit is given for this plane to G. C. Markov, deputy director of Andrei Tupolev's design bureau. The Tu-110 is credited by Soviet sources with a maximum speed of 620 mph., a cruising speed of 500 mph. at 36,000 ft. and a maximum range of 2,000 miles. Externally, it looks very much like the original Tu-104 design with the exception of its four turbojets in contrast to the twin engines of the 104 series. Engine design is officially credited to Lulko. The four turbojets in the Tu-110 appear to be the same utilized in the Tu-104 transport and the Bison and Badger bombers and are probably operated at the de-rated civil power of 14,500 lb. thrust.

Tu-104A

• **Tupolev 104A.** This is a new version of the Tu-104 series that has been operating on Aeroflot routes from Moscow to Peking and Prague for nearly a year. Main difference is a high density seating arrangement that increases passenger capacity to 70 in contrast to the 50 passenger original Tu-104 models now in service. This switch in the Tu-104 series interior, as well as the obvious emphasis on high density seating arrangements in the newer Moscow, Ukrania and Tu-110 designs, indicate that Aeroflot is becoming aware of some economic problems of large scale transport operations faced by foreign operators nearly seven years ago and is now pushing for high revenue capacity for its new jet transport fleet. Apparently, little design change was necessary to increase Tu-104 capacity except for eliminating the wood and plush upholstery of the original versions and substituting lightweight airline type seats and fixtures. Some additional power required for a heavier payload could be easily obtained by operating the Lulko turbojets at a higher power almost anywhere along their curve to the maximum 19,500 lb. thrust military rating.

Ukrania

• **Antonov Ukrania.** Prototype of this transport first flew last March (AW March 25, p. 41) but was publicly displayed for the first time in the Vnukovo show. Although officially credited to the veteran O. K. Antonov, the official Red Air Force newspaper has mentioned Nikolai Trunchenkov as the "leading designer" for the Ukrania. The Ukrania is powered by four Kusnetzov turboprops installed well forward and under the transport's high wing similar to the Rolls-Royce Dart installation on the Viscount.

Tailpipes exhaust under the wing, and the main landing gear wheels retract into bulges on each side of the fuselage with the nose gear pulling up into the fuselage.

Ukrania uses the same engines and propellers with streamlined spinners as the Moscow.

The four-engine Ukrania is the second of two Antonov turboprop transport designs, but the earlier twin-engine design shown at the Tushino air show last year (AW July 2, 1956, p. 26) has been abandoned in favor of the Ukrania design.

Ukrania is credited with a payload of 85 passengers and 7,000 lb. of cargo and has a cruising speed of 360 mph. at altitudes of between 24,000 and 30,000 ft.

Ukrania has fore and aft passenger loading doors and a large rear cargo door large enough to accommodate a truck.

The Ukrania is apparently one of the first Soviet transports in which special attention has been given to lightweight cabin furnishings. Soviet sources point out that conventional upholstery with metal springs has been replaced with foam rubber and the weight of the seats cut by 50% compared to earlier transport seats. Extensive use of plastics and lightweight metals has been engineered into the cabin furnishings including the lavatories and galley. Cabin is equipped with integral load-

ing ramp and has a carry-on baggage compartment. Cabin is pressurized.

Soviet sources emphasize that the Ukrania is designed to operate off dirt runways and grass airfields and has excellent short field landing and take-off characteristics. Since Aeroflot officials have emphasized the need for a capacious cargo plane, it is expected that the Ukrania also will be used in expansion of the Aeroflot cargo service.

Tupolev Russia

• **Tupolev Russia.** This giant turboprop powered transport is scheduled to be flying in prototype form before the 40th anniversary celebration of the Soviet's October Revolution next fall. It will have a double decker fuselage with a capacity of 150 passengers and will be powered by four 12,000 eshp. turboprops geared to contrarotating propellers. This power combination is now in service with the giant Bear intercontinental bomber. It is designed to cruise at 560 mph. and operate nonstop over the 4,000 mile Moscow-Khaborovsk stage length.

Soviet sources say the new jet transports are scheduled to go into both domestic and international service of Aeroflot "soon." If they follow the operational timetable of the original Tu-104, it will be about two years before they appear in significant quantities in regular Aeroflot service. The Tu-104 prototype made its first flight in the summer of 1955 and went into regular Aeroflot service on the Moscow-Prague and Moscow-Siberia routes late in 1956. Foreign observers estimate that Aeroflot is now operating about 30 Tu-104s in regular service.

If the same sort of operational timetable can be maintained for the new types by Aeroflot it will have a full-scale family of gas turbine powered transports in airline service almost a year before most of its foreign competitors will get initial fleet equipment of turboprop and turbojet transports. Only the British Britannia and Viscount will have been in extensive service before the Aeroflot jet family.

In outlining Aeroflot's plans for conversion to jet transports to AVIATION WEEK in Moscow last summer, Maj. Gen. Beletsky, Aeroflot operations chief, said the airline's bid for international routes would have to await the availability of suitable equipment.

Now that the new jet transports are flying in prototype form, it probably will not be long before Aeroflot begins active negotiations for traffic rights to the capitals of Western Europe, the Middle East and non-Communist countries in Asia.

The display of new transport aircraft was held at Vnukovo Airport, main commercial air terminal for Moscow, a week after the annual military aviation day flying display was scheduled for Tushino Airdrome. The June 30 military display was canceled officially because of bad weather forecasts but more probably because of the internal political dispute then rocking the top-level Communist leadership. At the Tushino display, it is customary for all of the Communist hierarchy to appear publicly on the balcony of the Central Flying Club in order of their rank. While the battle for top leadership was in progress between the factions headed by Nikita Khrushchev and V. I. Molotov this public appearance was obviously impossible.

British Claim Supersonic P.1B Exceeds 1,132 mph. Speed Record

Wharton, England—English Electric demonstrated its supersonic P.1 fighter last week, announcing at the same time that the first P.1B had exceeded the existing world speed record.

The company declined to state the exact speed but it is believed to be in excess of 1,200 mph. The official world speed record of 1,132 mph. at present is held by the Fairey Delta FD2, a research aircraft.

No attempt to capture the record over a measured course has yet been made by English Electric, but the company is planning to do this at the first opportunity.

The high speed run was made during development testing of the first P.1B, which is powered by Rolls-Royce RA24 Avon turbojets. Pilot R. B. Beamont throttled back because higher speeds had not then been authorized in the flight test program. The P.1 has in the past been described as a 1,500-mph. fighter.

Beamont, who is chief test pilot and manager of flight operations for English Electric, flew a P.1A prototype in the flight demonstration. After a 3,000 ft. takeoff run, he climbed steeply out and then banked into a steep right turn at about 1,500 ft.

He then put the aircraft through a flight demonstration which indicated good low speed handling characteristics and a reasonable rate of roll. Considerable mushing was apparent on the turn, during which Beamont was pulling more than 6 Gs. This is attributable to the low aspect ratio and high incidence of the sharply swept P.1 wing.

The aircraft, which Beamont was demonstrating, is equipped with two Armstrong Siddeley Sapphire engines without afterburners, which develop only half the thrust of the afterburner-equipped Rolls-Royce engine of the P.1B.

The P.1A which was demonstrated, was equipped with a test installation of a conical cambered wing leading edge similar to that of the Convair F-102. An English Electric spokesman said this is a test installation, and no decision has yet been made on whether it will be a production feature. No distinct advantage has been apparent from its use, he said.

Airbrake Redesign

Company officials said there had been no major aerodynamic troubles with the P.1 except a redesign of the airbrakes.

Twenty pre-production aircraft have been ordered for the P.1 development program. The aircraft is due to go into operational use by the Royal Air Force in late 1958. Exact extent of the order has not yet been decided, but the government has announced that this will be its last manned fighter, indicating a considerable development life for the P.1. One of the developments planned is the addition of a rocket motor.

English Electric says the closest U. S. equivalent in specification is the Convair F-106. The P.1 is designed as a weapon system which will carry guided missiles including the de Havilland Firestreak infrared air-to-air weapon. Cockpit is refrigerated.

Special flight instruments developed for the P.1 include a "roller-blind" attitude indicator which will not tumble at high climb angles.

Pursuit-Curve

The P.1 radar fire control system is designed to follow the RAF practice of pursuit-curve interception rather than the lead collision course of the USAF.

The English fighter is large enough to accommodate what the company describes as "the more sophisticated guided missiles" to be developed in the next few years.

Aerodynamic proving of the P.1 to its first production standard is almost completed, the company says. The P.1 is an all weather interceptor which started life designed to a Ministry of Supply specification for a research aircraft. It was planned from the start, however, for development into an operational airplane. P.1B operational prototype made its initial flight April 4.

Measurement of the P.1 high speed runs were by Machmeter and by recording instruments in the aircraft. There was no telemetering or ground measurement.

'Farside' Aims at 4,000-mi. Altitude

Washington—Before the year's end, a large rocket will be launched from a balloon high over Eniwetok Atoll in the Pacific in an attempt to attain a peak altitude of 4,000 mi., a distance roughly equivalent to the earth's radius. The launching will be the first firing in Project Farside (AW Dec. 3, p. 27), a research program sponsored by Air Research and Development Command aimed at uncovering secrets of natural phenomena in the far reaches of space surrounding the earth.

Farside is under cognizance of the Air Force Office of Scientific Research, commanded by Brig. Gen. H. F. Gregory. Heading the project under Gregory is a civilian scientist, Dr. Morton H. Alperin, director of advanced studies, AFOSR, Pasadena, Calif. Prime contractor for the project is Aeronutronic Systems Inc., a Ford Motor Co. subsidiary located in Glendale, Calif.

OSR conceived the broad configuration of the vehicle, the number of stages and number of rockets per stage. Aeronutronic conducted the detail design of the vehicle, is assembling it and developing avionics and associated instrumentation. University of Maryland also is conducting work on design of the instrument payload.

The name Farside is not descriptive of any phase of the project, and is in some respects misleading. Some missile circles have erroneously interpreted it to indicate that the program aim is to get a telemetered look at the far side of the moon never seen by man. The project may, however, be a stepping stone toward exploration of space phenomena on this side of the moon and lay the groundwork to help in the design of future manned vehicles to penetrate space in the region of the moon. Farside highlights include:

• **Project contract figure** is $750,000, an amount estimated to be about 1/30th that of the cost of the Vanguard satellite project to date.

• **Project won't depend** upon a single firing. To insure a reasonable chance of attaining the 4,000 mi. altitude and gathering wanted data, six operational rounds are being built—six rockets, six sets of instrumentation, six launching balloons. This equipment is now about 80% complete.

• **Rocket is about 30 ft. long,** varying from approximately 8 ft. in diameter at the base to about 4 in. in diameter at the last stage. Material is aluminum alloy, but the nose cone and critical parts, such as the telemetry transmitter, are protected by a sheath of stainless steel.

• **Instrument payload** is under 10 lb. Rocket's extremely high acceleration

FARSIDE 5½ hr. balloon test last month checked stability, environmental factors.

posed difficult instrumentation development problems for Aeronutronic, which has produced rugged, reliable equipment for the job. Data will be telemetered back to earth with a specially developed transmitter weighing about 2 lb. Aeronutronic also has developed the receiving equipment, a critical job more difficult than the transmitter.

• **Balloon launch will be used.** If the rocket were launched from a ground pad it would burn up as a result of extreme heat generated by air friction during the very high acceleration. Balloon will release the rocket at approximately 100,000 ft., which is above 90% of the earth's atmosphere. Balloon launch is not capable of providing an accurate trajectory, but this is not needed in Project Farside.

• **Four stages of propulsion** are used. Solid propellant motors already in existence were selected to keep within the limitations of money available for the project. First stage motor consists of four Thiokol Chemical Corp. Recruit rockets as used in the Lockheed X-17 reentry test vehicle. Second stage is a single Recruit. Third stage consists of four Grand Central Rocket Co. motors now being used in Cooper Development Co.'s ASP sounding vehicle. Fourth stage is single ASP motor.

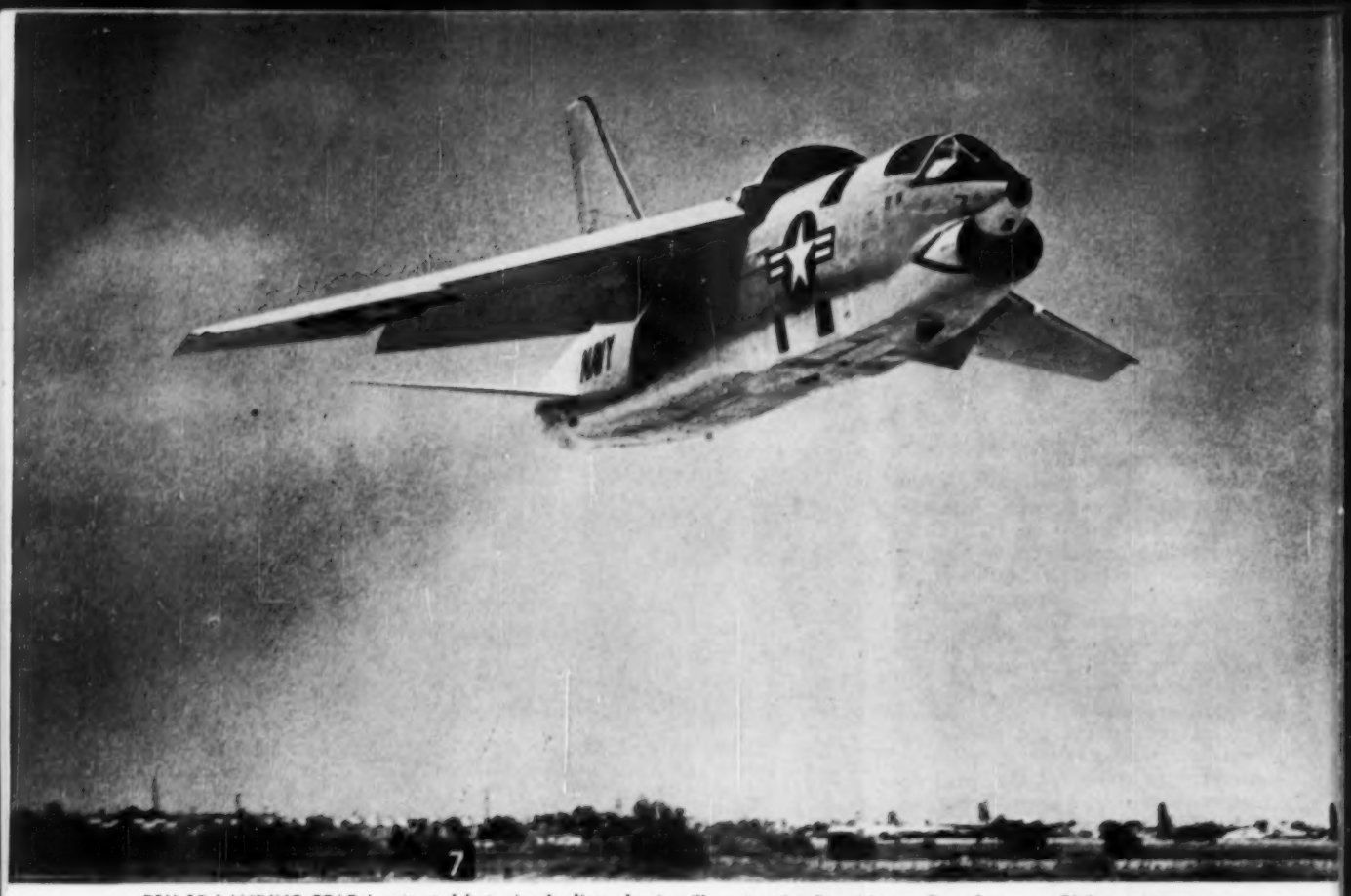
• **Total burning time** for all four stages is only eight seconds. First two stages will fall back to earth after burnout, this being one of the primary reasons why an over-water area was selected as the launching site. Last two stages will burn in their fall toward earth.

• **Top speed** will be approximately 25,000 fps.—17,000 mph.—at the end of the last rocket motor burnout. Then, the rocket will begin slowing down until it reaches zero velocity at the 4,000-mile altitude.

• **Included in basic data** to be gathered will be information on the earth's magnetic and gravitational fields, origin and nature of cosmic rays, ionosphere measurements, meteorite densities.

A preliminary test, a successful balloon flight experiment, for Project Farside was carried out on June 28 at General Mills Co.'s flight test center near New Brighton, Minn. General Mills has designed and is producing the balloons for Farside. During the preliminary test, a 1,500 lb., 200-ft. diameter helium-filled balloon carried a rocket and instrumentation weighing in excess of 2,300 lb. to an altitude above 104,000 ft. The rocket motor chamber contained iron filings to simulate weight conditions.

Atmospheric data was telemetered to ground during the flight, and cameras in the balloon gave information on flight behavior. Equipment was successfully parachuted to ground.



F8U-1P LANDING GEAR is retracted but wing leading edge is still up in takeoff position as Crusader passes 50-ft. over runway.

Afterburner Pushes F8U-1P to Trans-U. S.

By Erwin J. Bulban

New York—Navy successfully proved the feasibility of using afterburner power during the major portion of a tactical mission last week by flying a Chance Vought F8U-1P Crusader nonstop from California to New York at an average speed of Mach 1.1.

Peak speeds attained during the flight exceeded the Thompson Trophy speed record of 1,015 mph. set by a Crusader in August, 1956.

Maj. John Glenn, Jr., USMC, flew the F8U-1P from Los Alamitos NAS, Calif., to Floyd Bennett NAS, N. Y., in 3 hr. 23 min. 8.25 sec., refueling aloft three times en route. Much of the flight was made at altitudes of approximately 50,000 ft., although his average altitude for the distance was about 35,000 ft.

Maj. Glenn broke the previous official record of 3 hr. 44 min. 53.8 sec. for this distance set by a USAF Republic F-84F Thunderstreak in 1955.

Navy officials emphasized that the new record set by Maj. Glenn was no mere speed exercise but a serious study of the tactical potential provided by continuous use of afterburner power by combat aircraft. As such, the mission, coded Project Bullet, was planned by Naval Air Test Center, Patuxent River, Md., under personal supervision of the station's commanding officer, Rear Adm. Thurston B. Clark, who monitored the entire flight from Floyd Bennett NAS operations room.

The example successfully set by the Crusader obviously can also be used to similar tactical advantage by other air-refuelable afterburner-equipped military aircraft to increase combat potential.

Afterburner engines have been successfully run for longer periods on the ground in test. Pratt & Whitney aircraft, which designed and built the J57-P-4A engine in the F8U-1P, has tested engines on afterburner power continuously for periods exceeding three hours at various simulated altitudes in the company's Willgoos Laboratory, AVIATION WEEK learned. But the Crusader's record flight marked the first time this feat has been accomplished for long periods aloft.

J57-P-4A in the F8U-1P delivers approximately 16,200 lb. thrust with afterburner operating.

Reconnaissance cameras in Major Glenn's F8U-1P made a continuous black-and-white strip photograph of the U.S. from coast-to-coast, while other cameras recorded the ground in color, pointing up fact that the Crusader was carrying full equipment and was flying a typical tactical-type mission.

Adaptation of the Crusader to photo missions has necessitated important fuselage redesign to accommodate camera gear while at the same time maintaining the airplane's supersonic capability. Flattening the fuselage belly to permit installation of optically flat glass for distortion-free photos required Chance Vought engineers to apply the area rule by bulging the fuselage top to match the squared-off area underneath. Close study of the photo (p. 32) shows the slight hump above the Crusader's star-and-bar national insignia.

Maj. Glenn reported that the airplane, engine and every item of equipment functioned without incident throughout the flight and he felt that he had gotten maximum performance from the airplane for the distance. He said that he might get greater assistance from winds if the flight were held during the winter, noting that summer winds

SQUARED-OFF BELLY of F8U-1P has optically flat transparent panels through which reconnaissance cameras cover wide areas.

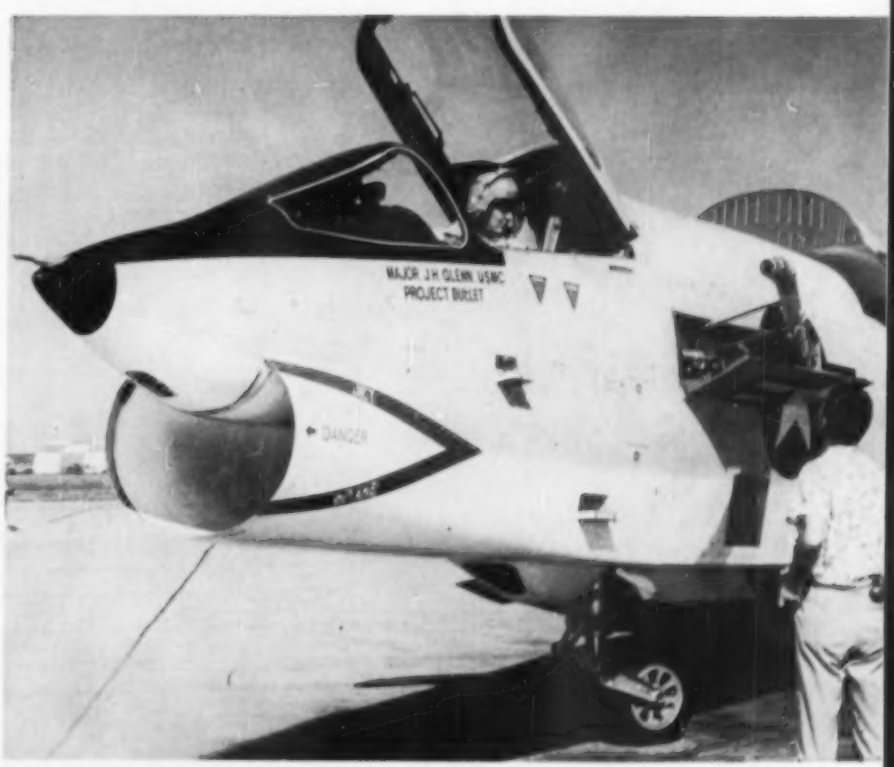
Speed Mark

are slight and variable. Maximum tailwind assist, and this only briefly, was about 15 kt., he said. Weather at Los Angeles was marginal at takeoff, with ceiling of 600 ft., but he was through the cloud cover in 15 sec. and set up for cruise climb, allowing the airplane to climb as it burned off fuel.

Navy sent two Crusaders from California Maj. Glenn's photo-reconnaissance F8U-1P version and an F8U-1 piloted by NATC test pilot Lt. Cmdr. Charles Demmler, USN.

Demmler was forced out of the running when his refueling probe hit the tanker's extended drogue too hard, bending the probe and causing it to oscillate strongly, prohibiting a successful contact. He landed at Albuquerque, N. M.

Indications are that use of the retractable probe mounted in the left side of the fuselage behind the cockpit takes considerable skill to engage. Maj. Glenn reported that he lost about 20 seconds by missing the drogue on the first pass over Albuquerque, requiring slow-up to allow the tanker to pass him so he could engage. He also lost about a minute near Indianapolis locating



RETRACTABLE FUELING PROBE behind F8U-1P cockpit is covered by flat panel common to late production Crusaders in contrast with earlier bulging cover (AW June 17, p. 37).

the tanker that was on station there.

Navy furnished eight North American AJ piston-engine tankers for the flight. Two were over Indianapolis, three each over Olathe, Kans., and Columbus, Ohio.

A Douglas A3D Skywarrior was used as a pathfinder, taking off about an hour ahead of the Crusaders and checking actual weather conditions en route and communications facilities. The pathfinder proved valuable to Maj. Glenn in reporting cloud heights, winds, permitting optimum positioning of the tankers. It landed at Floyd Bennett about 4 hr. 10 min. after leaving California, blowing a tire after the parabrake failed to open.

Flight pointed up the need for jet-powered aerial tankers to gain maximum capability from the new generation of supersonic fighters, Adm. Clark told AVIATION WEEK. Use of obsolescent AJs was necessitated because A3D tankers are not yet operational.

Crusaders' flights were planned so they would have 1,100 lb. of fuel remaining at each AJ contact point. If successful contact with the AJs was not made, the Crusaders could follow a tanker to its base. The F8U-1P took on 1,300 gal. at each fuel contact. Jet fuel counts out at approximately 6.8 lb. to the gal. Maj. Glenn was running near the critical point on fuel when near New York, arrived at the field with 300 lb. remaining, enough to have made a second "very tight" pass. The F8U-1P model carries somewhat more fuel than the F8U-1.

Letdown from 50,000 ft. to the air station started 65 mi. from the city.

French Order Mirage III Tooling, Indicating Choice Over Trident

Paris—Avions Dassault received a firm order from the French Air Ministry for ten preproduction models of its supersonic Mirage III fighter plus a tooling order which indicates the Air Ministry probably will order "several hundred" of the delta wing aircraft.

Prototype Mirage III, which to date has made 70 test flights, is powered by Snecma Atar 61 turbojet.

Production models probably will be fitted either with a Snecma Atar 8 or an afterburner version of the same engine, the Atar 9, which develops over 13,000 lb. thrust.

Mirage III was flown by once during the recent Paris air show, but generally has been kept tightly under wraps by the Air Ministry.

Rocket Engine

Dassault is equipping Mirage prototype with an SEPR single rocket unit slung under the fuselage. The aircraft, on its turbojet alone, reportedly has flown at Mach 1.6 (AW June 10, p. 19).

The company also is experimenting with the possibility of launching the Mirage from a Matador type ramp.

Ordering of the Mirage indicates the Air Ministry favors this aircraft over the rocket-jet powered Trident II. French Air Force does not have enough budget funds to order both.

Since Mirage III has both interceptor and fighter-bomber capability, while the Trident is strictly an interceptor, this versatility may have tipped scales in favor of Mirage. The French Air Force some time ago ordered 10 preseries Tridents but since then has not indicated that it plans to follow with a production order.

Sud Aviation, Trident builder, currently is working on a pilotless version of the Trident design for use on missile missions.

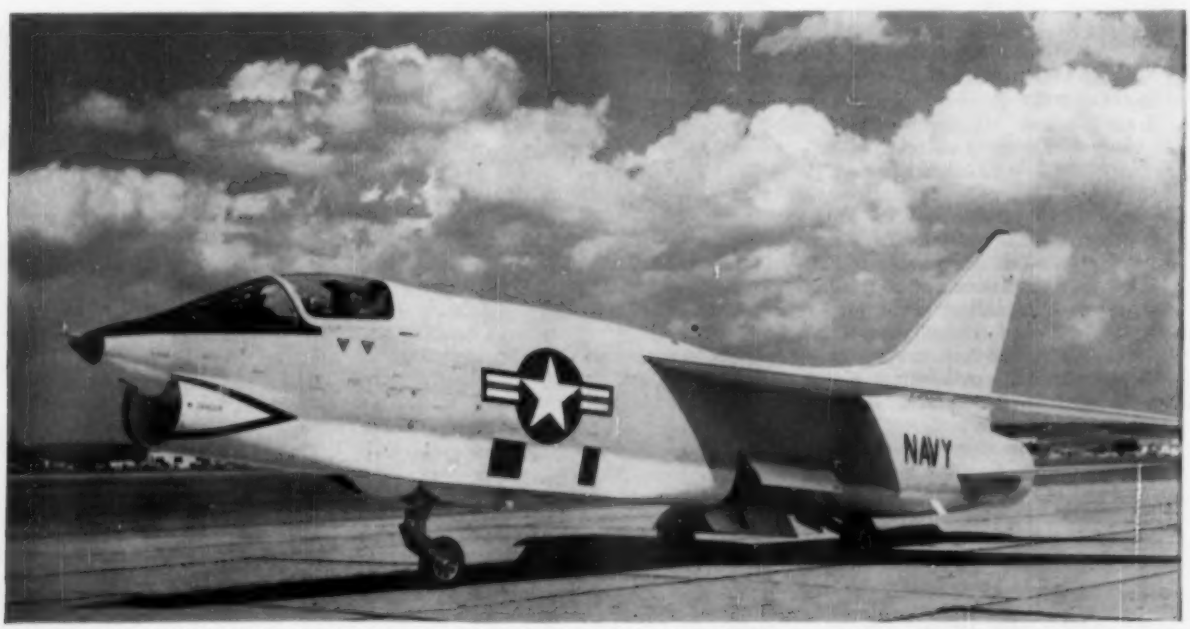
First Flight

Mirage III made its first flight Nov. 11. An earlier version, Mirage I, first flew in June, 1955.

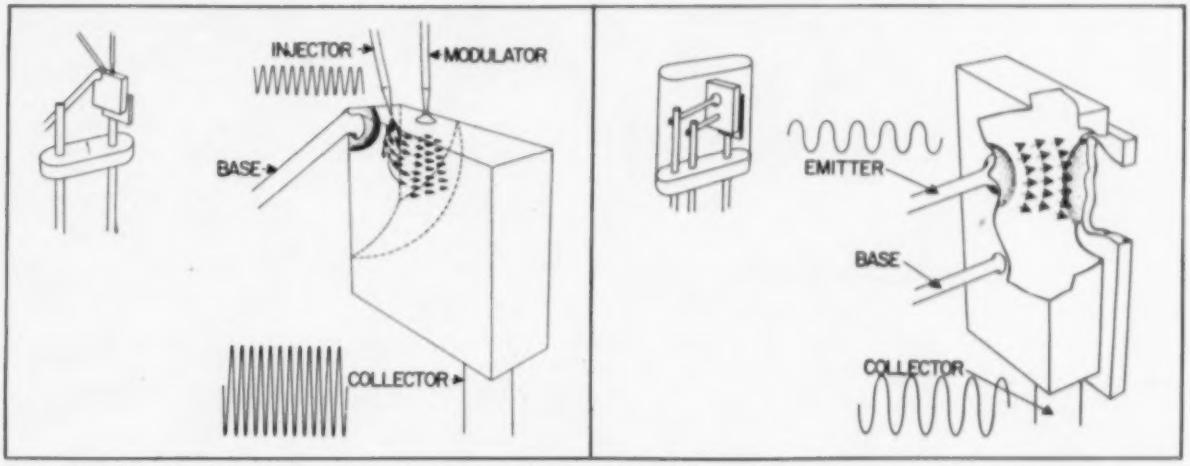
The Mirage I, like the present flying version of the Trident, was powered by two Dassault-built Viper turbojets plus one SEPR rocket engine for added combat power.

Mirage III is designed to carry out high altitude interceptor missions as well as tactical support tasks. Depending on mission requirements, the aircraft is equipped with a radar unit for long range detection and missile firing or with rapidly removable 30-mm. cannons in fuselage and three underwing adapters for carrying bombs, rockets, napalm or fuel tanks.

Dassault also is builder of the Mystere fighter series, in operational use with the French Air Force and with those of other nations.



SLIGHT HUMP atop F8U-1P fuselage behind cockpit is tipoff to how Chance Vought engineers applied additional area rule to compensate for squared-off belly housing cameras. Another revision on F8U-1P Crusader is relocation of pitot tube to pointed nose.



SPACISTOR (left) resembles transistor (right) in some ways, but promises major gains in high frequency performance.

'Spacistor' May Breach Transistor Limits

New York—Radically different type of transistor which may amplify at frequencies up to 10,000 mc., 10-50 times higher than conventional transistors, and at temperatures to 500C, several times above present limits, was disclosed here last week by Raytheon Manufacturing Co.

Principles of the new semiconductor amplifier, which Raytheon calls a Spacistor, were simultaneously reported by company scientists at a conference of semiconductor scientists in Boulder, Colo.

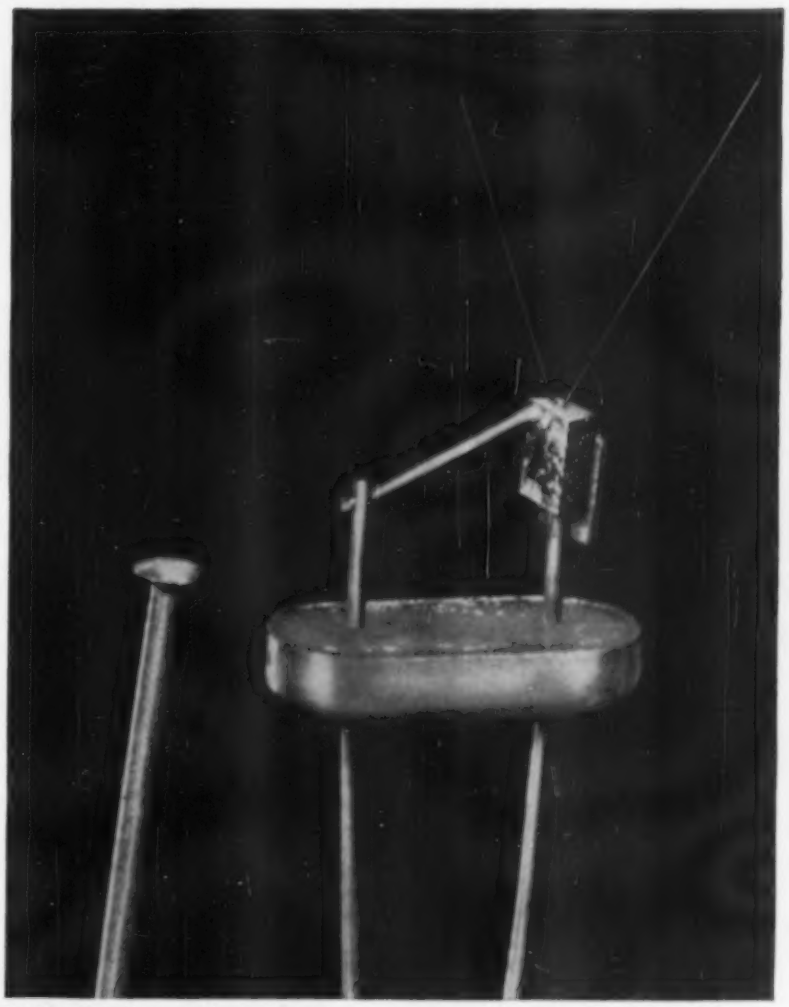
Raytheon says the device has several important additional advantages over conventional transistors, including:

- **Extremely high input** impedances. Disadvantage of conventional transistors is their low input impedance compared to vacuum tubes. New Spacistor has input impedance of 30 megohms in experimental models. Further increases appear possible, Raytheon says.
- **Very low output capacitance.** Values less than one micro-microfarad appear entirely feasible, according to Raytheon, opening the way to very high frequency circuitry.
- **Almost complete isolation** of input-output circuitry. Coupling between input and output in conventional transistors has placed them at disadvantage with respect to vacuum tubes in certain applications.

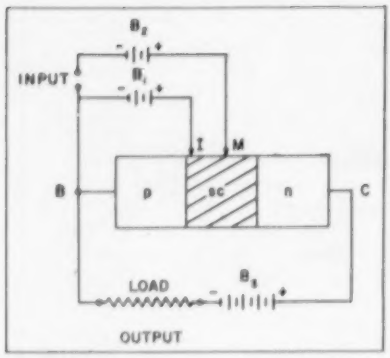
Raytheon emphasizes that the new device still is in the laboratory stage. It may be a year before even sample quantities are available to industry; perhaps two years before production quantities.

So far Raytheon has fabricated less than a dozen of the germanium Spacistors.

Spacistor performance predicted by Raytheon is based on theory, not ex-



EXPERIMENTAL unit, shown alongside a pin, consists of small semiconductor diode with two additional electrodes. One provides source of electrons. The other serves as modulator control element. New device is still in laboratory stage.



SCHEMATIC diagram of Spacistor shows polarity of bias voltages. Space charge area (SC) is exaggerated.

perience. Existing devices have been operated only at low frequencies and room temperatures.

However, their behavior and performance have closely followed theory and this strengthens Raytheon's confidence in its predictions of Spacistor future capabilities.

Present experimental units have demonstrated power gains as high as 70 db., and voltage gains of 3,000, according to Dr. Harry Letaw of Raytheon's Research Division.

Letaw says that "enormous" gain-bandwidth products (figure of merit) appear possible with the Spacistor, but he adds that such measurements have not yet been made.

Raytheon says its too early to talk prices for the new device. However, Letaw says that its price should be comparable to that of a conventional transistor designed for high frequency use.

New Principle

The relatively slow speed of charge carriers (electrons or "holes") through a transistor's base region has been the major roadblock to raising its upper frequency limit. Several different techniques have been developed to improve frequency response, including reduction of base region thickness, creation of internal fields to speed charge carrier movement.

Raytheon believes its approach is so novel that the resulting device is not a transistor, hence the company coined name of Spacistor.

However, an acknowledged semiconductor expert who attended the Boulder meeting told AVIATION WEEK that Raytheon's device resembles a point-contact version of an analog transistor already patented by Bell Telephone Laboratories.

He agrees with Raytheon that the new device may be able to use new high temperature materials with short carrier lifetimes which are not suitable for ordinary transistors.

However, he questions Raytheon's predictions of extremely high frequency operation on several scores. One is the low ratio of transconductance to output capacitance. Raytheon admits that transconductances achieved so far have been low, but says they can be increased.

The paper was delivered at Boulder by Raytheon's Dr. Hermann Statz.

Reversed Bias Junction

Raytheon's Spacistor consists of a simple P-N junction (diode) instead of the two back-to-back junctions employed in a conventional transistor. This eliminates the base region which slows current flow in a conventional transistor.

A load and voltage (B3) is connected across junction with reverse polarity. This reverse bias permits practically no load current to flow, but does create a very useful space charge region (identified SC in sketch) in which strong fields exist.

A third element, called the "injector," is the source of load current. It is biased at a potential which is lower than that of the space-charge region which it contacts, so that it injects electrons into the space-charge region. The strong field within this area speeds the electrons to the collector and to the load.

A fourth electrode, called the "modulator," also connects to the space-charge region between the injector and the collector. However, the modulator is connected through a small P-type junction and biased (B2) so that no appreciable current flows into or out of the modulator. Instead the modulator produces a field which extends throughout the space charge region, its strength depending upon the voltage applied at the modulator.

Modulator Function

When input signal is applied to the modulator, it changes potential in space charge region, producing proportional change in flow of electrons out of the injector. Space charge field speeds these electrons to collector, out to load, producing proportional change in load voltage.

Modulator also serves to prevent self-quenching, an adverse feedback which discouraged early experimenters. Modulator bias voltage "anchors" potential of space charge field between modulator and base, preventing changes in load current from producing counteracting changes in space charge potential at the injector.

Navarho Future

Future of Navarho, official U.S. contender for international long-range air navigation system will be discussed at Rome Air Development Center symposium this week (July 23, 24). Attending government officials will be briefed on results of Rome's Navarho evaluation program and proposals for expanding the rho-theta system to include hyperbolic position-fixing capability.

In addition to the military services and civil aviation agencies, the symposium will be attended by representatives of the State Department Federal Communications Commission and the Weather Bureau.

Bendix Trophy Race Scheduled for July 28

Washington–Bendix Trophy Race will be held this year on July 28 when six Convair F-102 jet interceptors from the Air Defense Command will seek a new speed record on a run from Chicago to Andrews AFB outside Washington.

The Bendix event, long a feature of the now-defunct National Air Races, will be held in connection with the Air Force Assn.'s National Air Power Review, marking USAF's 50th Anniversary and the opening of AFA's 11th annual convention.

Two other flying events will highlight AFA's celebration:

- **Fourth annual Earl T. Ricks** Memorial Trophy Flight, also on July 28, will be flown by 12 Air National Guard pilots in Republic F-84Fs. They will fly 2,330 nautical miles from Fresno, Calif., to Andrews. The planes will refuel three times on the trip.
- **French Nieuport 28 Scout** and German Fokker D-VII, both veterans of the World War, are flying from Van Nuys, Calif., to Andrews in an eight-day tour over a route similar to that taken in the Ricks Trophy event.

The 1917 aircraft are being flown by Frank Tallman of Glenview, Ill., who owns both of the aircraft, and Cliff Anderson of Pomona, Calif. They were to make 21 stops in 10 states before arriving in Washington. The course covers 2,426 nautical miles.

Major feature of the AFA convention for industry will be the annual briefings by USAF's Air Materiel Command and Air Research and Development Command on July 31 at the convention headquarters, Sheraton-Park Hotel. The Airpower Symposium will be held on Aug. 2.

Industry also will take part in the Airpower Panorama at the Washington National Guard Armory. The display of air weapons and equipment will be the biggest show of its kind now that the annual Labor Day exhibit of the National Air Show has been called off.

Gen. Carl A. Spaatz, first USAF Chief of Staff, is general chairman of the convention.

PRACTICE MAKES PERFECT—In 1957, as in 1776, one measure of effective defense is the true aim and steady skill of a nation's fighting men. To make American warriors proficient against complex modern weapons, Northrop Aircraft's subsidiary, Radioplane Company, produces targets like the rocket-powered RP-70 type, a light, low-cost drone, which simulates a high speed modern jet plane or missile at stratospheric altitudes. Like Northrop's new supersonic Air Force trainer airplane and Snark SM-62 intercontinental guided missile, the RP-70 is another example of the Northrop-Radioplane policy of "*security with solvency*" which applies advanced science and technology to deliver the maximum in national defense for the minimum in tax dollars.

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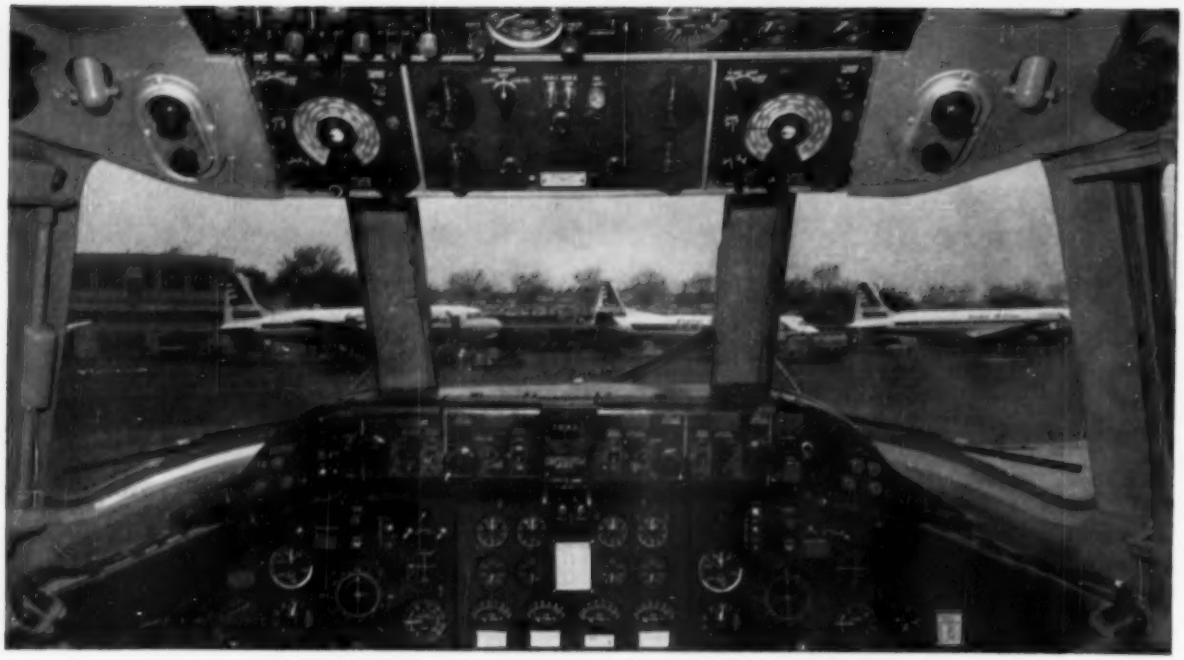

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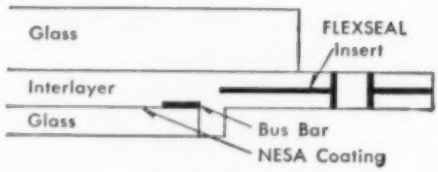

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USAF, BuAer Formalize Plans For Procurement Stretchouts

By Katherine Johnsen

Washington—Air Force and Navy Bureau of Aeronautics are formalizing plans for a major stretchout of their procurement and research and development programs as a result of a directive from the director of the Bureau of the Budget, spelling out the President's plan to hold down the Fiscal 1958 defense program (AW June 10, p. 33).

Steps taken thus far are considered only a prelude. These have included slowdowns in USAF's B-52, KC-135, and 100-series programs; elimination of USAF's Navaho missile program (AW July 15 p. 29), and cancellation of Navy's A4D-3 and a curtailment of Navy's W2V-1 program (AW July 1 p. 28).

Budget Director Percival F. Brundage's letter directed that "the rates of commitments, obligations and expenditures for Fiscal 1958" be kept at, or below, the Fiscal 1957 level.

$4 Billion Squeeze

In testimony before the House Appropriations Committee, Brundage testified that Fiscal 1957 defense expenditures are estimated at $38.3 billion and that the ceiling for Fiscal 1958 is $38 billion. At present rates, the Fiscal 1958 expenditure would reach $42 billion or more, indicating that at least $4 billion will have to be squeezed out of the program. Anticipating the order, USAF already has given industry guidelines for survival under the spending ceilings (AW July 1, p. 26).

The announcement by Defense Secretary Charles E. Wilson of a 120,000 reduction in military manpower over the next six months is a first step to make immediate reductions in expenditures.

The Brundage letter is directed at obligations, which would be reflected in the letting of new contracts, as well as expenditures, which would be reflected in payments on production underway.

Budget Bureau Guidelines

He lays down these policies under which Budget Bureau will "apportion" or release funds:

• **"Requests for apportionment** and the allotment of funds shall be based upon holding obligations to absolute minimum levels. . . . In any case where special circumstances . . . prevent the agency from operating at or below the 1947 levels, the agency head shall submit a statement of reasons therefore to accompany the apportionment requests. . . ."

• **"In the case of those appropriations** that are for major capital outlay and development – construction, procurement, research—the requests for apportionment and the allotments should reflect the postponement of a significant part of the obligations planned in the budget for 1958."

Following an executive session of the House Armed Services Appropriations Subcommittee with Brundage, Rep. George Mahon (D.-Tex.), chairman of the group, commented that "at its face value, (the directive) will have a terrific impact on the defense program—but he glosses over this in his verbal testimony."

Outlook

Here is the outlook:

• **Bureau of Aeronautics reports** there will be no terminations of major programs. But the bureau is working on plans to stretch out production already under way, postpone progress payments and slow down the letting of new contracts.

• **USAF programs** likely to be hit appear to be: First, the F-106, the Rascal, Matador, and Falcon programs; second, the F-104, the F-101B, F-105 and the C-130 programs; third, the KC-135 and B-58 programs.

Meanwhile, K. E. Fields, general manager of the Atomic Energy Commission, reported that the Brundage directive to hold outlays to the Fiscal 1957 level will mean a sharp curtailment in AEC's weapons program. He told the House Armed Services Appropriations Subcommittee that this would involve a change in the military requirement and "it would mean the closing down of quite a number of plants."

Congress Reaction

The Brundage directive appeared to minimize the outcome of the Fiscal 1958 defense appropriation bill in Congress.

To legislators it added up to this fact: even if the higher amounts allowed by the Senate over the House allocations for aircraft procurement and for research and development were allowed, they would not be "apportioned" for use to the services. Amounts were:

• **Aircraft procurement.** The Administration requested $7.1 billion for USAF and BuAer; the House allowed $7.6 billion; the Senate $8 billion.

• **Research and development.** The Administration requested $826 million for USAF and BuAer. The Senate restored a 10% cut made by the House.

Navaho Cut Spurs Layoffs

Los Angeles—North American Aviation Inc., hit by USAF's cancellation of the Navaho intercontinental cruise missile project (AW July 15, p. 29), announced last week it is laying off 6,305 employes as a first step toward a planned reduction of 15,600.

Layoffs, which included engineers, production workers and technical and office employes, affected four North American divisions, all of them in the Los Angeles area:

- **Missile Development, 3,705 employes.**
- **Autonetics, 1,000.**
- **Los Angeles, 1,450.**
- **Rocketdyne, 150.**

Before the layoffs, North American employed approximately 69,000 persons for its operations in California, Missouri, Ohio and Florida, with some 51,000 located in the metropolitan Los Angeles area.

At the time of its cancellation, Air Force had put approximately $500 million into the Navaho project, begun in 1946.

North American reports that the cancellation required the termination of $35 million in orders to 2,680 Navaho suppliers 900 of which are located in the Los Angeles area.

North American invited other companies to its plants last week to cull the list of laid off employes for hiring. Reaction from the United Automobile Workers, CIO-AFL, was a statement from Leonard Woodcock, vice president and director of the union's aircraft department, laying responsibility on the government to help the discharged employes by providing emergency job placement centers, a severance pay policy and directing other work to the company to create new jobs.

"It is not enough for the Defense Department to make its determinations purely on the basis of judgment of national defense needs or of the politics surrounding the argument over the national budget," he said. "It must at the same time be prepared to alleviate the ills which such decisions impose on the workers affected."

AEC Describes Effectiveness Of Radioactive Fallout as Weapon

By Evert Clark

Washington—Use of radioactive contamination to demobilize "areas, factories or equipment" without destroying them has become "an automatic extension" of the use of high-yield nuclear weapons, Defense Department and Atomic Energy Commission said last week.

In "The Effects of Nuclear Weapons," an updating of the seven-year-old report "Effects of Atomic Weapons," AEC and Defense said use of radiological warfare as a deliberate offensive weapon has been considered "for some time" but that difficulty of production, stockpiling, handling and delivery of effective radiological agents had made this impractical.

"The situation has undergone a change with the development of bombs having high fission energy yields," the book states. "The explosions of such bombs at low altitudes can cause radioactive contamination over large areas that are beyond the range of physical damage. Consequently, they are, in effect, weapons of radiological warfare.

"Instead of preparing and stockpiling the contaminating agent in advance, with its attendant difficulties, the radioactive substances are produced by fission at the time of explosion."

Basic idea of this type of warfare, the handbook said, is to make the use of enemy areas, factories or equipment "either impossible or very hazardous without any accompanying material destruction." Desirable radiological warfare agent would be effective for weeks or months.

The handbook was prepared by the Armed Forces Special Weapons Project. It is a detailed review of general nuclear weapons effects, based on data obtained from the 58 test shots fired up to 1956 and the atomic bombs dropped at Hiroshima and Nagasaki in World War II.

Effects information is calculated for yields of up to 20 megatons (equal to 20 million tons of TNT) and scaling laws for hypothetically extending calculations beyond that are given, but the book cautions that 20 megatons is "not to be taken as an indication of capabilities or developments."

Neither specific weapons nor types of weapons—for example, air-to-air rockets with nuclear warheads—are discussed. This is the first revision of the AEC-Defense handbook since the development of the so-called hydrogen, or fusion bomb, and the combination fission-fusion bombs.

The book notes that, weight for weight, "fusion of deuterium (heavy hydrogen) nuclei would produce nearly three times as much energy as the fission of uranium or plutonium." Tritium, another hydrogen isotope, fuses even more rapidly, and produces more energy than deuterium and also emits neutrons which "are able to contribute to the fission of uranium and plutonium, thus adding to the total energy release of the combined fission-fusion system," the book said.

Some information on effects of lower yield weapons on parked aircraft, industrial structures, machine tools and ships is included. Most of it is based on tests at AEC's Nevada Test Site but some is from data gathered after the Japanese bombings. Ship data comes from the Bikini Baker shot in the Pacific in 1946. Included are:

• **Overpressures of 6 psi.** will completely destroy parked aircraft. Overpressure is the pressure above that of the atmosphere (14.7 lb. at sea level). Overpressures of 4 psi. damage parked aircraft beyond economical repair, and an overpressure of only 3 psi. will cause enough damage so that major shop repair is required. To give some idea of distance from a burst at which destructive peak overpressures might be expected, a one megaton bomb would produce an overpressure of 5 psi. at a distance of 2.25 miles, and a 20 megaton explosion would produce a 5 psi. overpressure out approximately as far as six miles.

Aircraft parked with noses toward the burst will suffer less damage than those with side or tail pointed toward the blast wave.

These damage ranges are based on military aircraft exposed to bombs in the kiloton range and are applicable to "transport aircraft of the type utilized by commercial air carriers, parked in

Accountant Makes First Flight

Aviation Traders Accountant turboprop executive transport takes off from Southend Airport, England, for its first flight. The 28 passenger transport is powered by two Rolls-Royce Dart Da. 6 engines developing 1,730 eshp. each. Span is 82 ft. 6 in.; length 62 ft. 1 in., and height 25 ft. 3½ in. Estimated cruising speed is 256 kt.; maximum range under visual flight rules, 2,420 mi. Gross weight is 28,500 lb. and stalling speed flaps down is 69 kt. This model is equipped with four abreast seating, but is convertible to an executive layout. Later version, with stretched fuselage, would have 40 passenger seats and VFR range of approximately 275 statute mi.

the open at random orientation with respect to the point of burst."

Bombs of higher yield may produce different results, due to longer duration of blast exposure at any given point, the handbook cautions.

Copies of "The Effects of Nuclear Weapons" can be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for $2.

Temco Appeals Ruling On Renegotiations

Dallas—Temco Aircraft Corp. appealed to the U.S. tax court last week in an effort to overturn a Renegotiation Board ruling that the company must return over $1 million in excess profits.

With its appeal, Temco joined a growing group of aircraft firms now fighting Renegotiation Board rulings in the tax courts. The list includes Douglas, Boeing, North American Aviation, Grumman and Fairchild.

Renegotiation Board decided in April that Temco's 1953 profits of $9,069,000 were excessive by $3 million. After tax adjustment, this meant the company would have to return $1,003,790.

Temco's appeal says the board failed to give enough consideration to the company's efficiency and particularly to attainment of quantity and quality production, reduction of costs and economy in use of materials, facilities and manpower.

The company argued that its 1953 earnings, like those of the aircraft industry generally, were low by comparison with other large industries and that the board did not give sufficient consideration of the risks involved in aircraft production.

Temco asked the court to recognize favorably its status as a successful, growing company using its profits primarily for reinvestment and for expansion of defense production capabilities.

Bill Proposed to Favor Competitive Bidding

Washington—Legislation designed to restrict the area of contract negotiation in favor of competitive bidding by the military services has been introduced by Rep. Carl Vinson (D.-Ga.), chairman of the House Armed Services Committee. Key provisions of the measure are:

• **Eliminate the authority** of Defense Department to negotiate contracts by virtue of the emergency declared by the President. This is directed at the present situation in which the services can justify negotiation under the emergency declared by former President Truman in 1950 at the start of the Korean war. The Truman declaration has never been revoked. There would remain, however, the 16 other possible exemptions from competitive bid contracting of the 1947 Armed Services Procurement Act. These include: "public exigency," "impracticable to secure competition by formal advertising," "experimental, developmental, or research work;" "classified purchase;" "requiring substantial initial investment."

• **Require negotiations to be** "open" with the exception of classified procurements and that all submissions be made public after an award has been made. At present only the successful bidder's price is made public.

• **Direct the Secretary of Defense** to establish uniform procurement regulations for the three military services. "The Secretary has established some regulations and Army, Navy and Air Force have also established their own regulations," Vinson objected.

"At present, the various service regulations are often inconsistent and frequently establish wholly different procedures. . . ."

Convair Completes 880 Mockup Details

Washington—Convair has completed the mockup of the cabin interior of the 880 jet transport with a variety of interior configurations on display.

Cabin arrangements vary from luxury, four-abreast 88 passenger standard seating to the five-abreast 109 passenger coach.

Wind tunnel tests on the empennage to evaluate control system design have been completed. Low-speed and high-speed tests were run on a scale model of the 880 empennage which consisted of a tail cone, vertical fin and horizontal stabilizer. Acoustical tests on the fuselage wall panels are continuing and tests to determine the structural integrity of the wing fuel tank have started.

Convair has ordered the Sperry SP-30 autopilot. The SP-30 is a gyroscopic and servocontrol type of autopilot, the latest in a series which has been tailored to the operational needs of highspeed jet airplanes. It employs transistors in place of vacuum tubes, which in conjunction with printed circuits has resulted in the development of a high-gain system and significant reduction in weight and bulk.

The current tooling program status figures reflect a total of 11 production mockups completed and 18 in-work, while 80 basic tooling structures are completed and 150 are in-work.

The 880 wing anti-icing system will feature a chemically-milled aluminum skin in the leading edge. Grooves are milled into the inner surface of the skin and a thin aluminum skin is attached to this surface, forming a double skin. Hot bleed air from the engine flows through the grooves and dissipates 87-97% of its original heat.

News Digest

General Electric received first production contract for its Vulcan 20-mm. cannon, a $7 million USAF award to the missile and ordnance systems dept. at Burlington, Vt. Vulcan, a high rate of fire weapon operating on a "Gatling gun" principle, has been produced under two previous research and development contracts, but this is the first formal production award. Vulcan is installed on the Lockheed F-104A Starfighter and other jet aircraft.

Research and development contract of $4,539,772 for the Quail GAM-72 ground-to-air electronics countermeasures missile has been awarded McDonnell Aircraft Corp. by the Air Materiel Command.

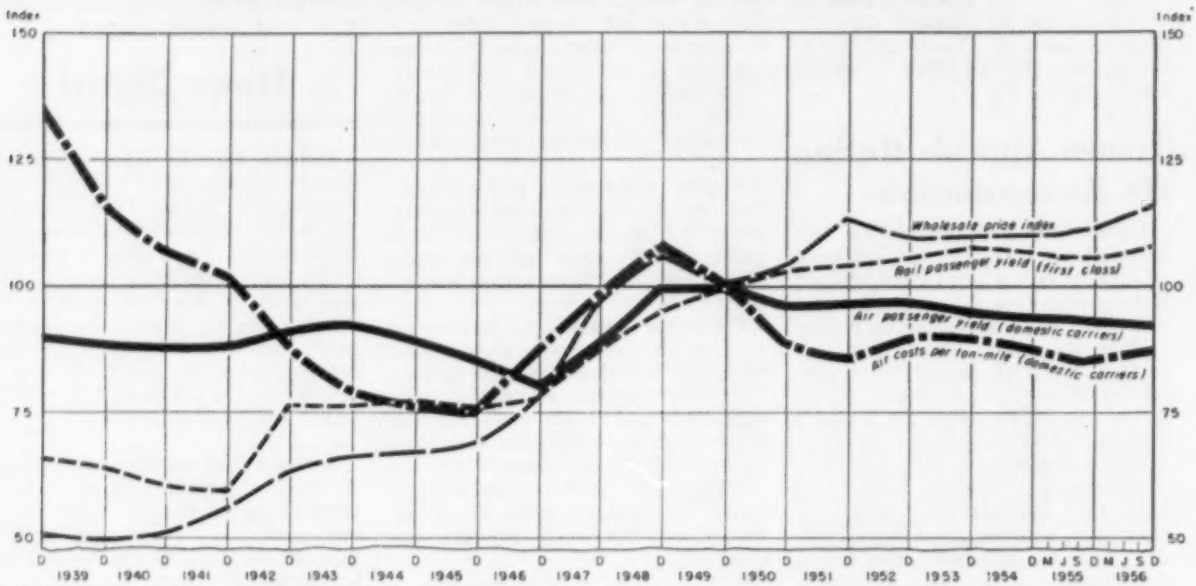
Douglas Aircraft Co. in move to tighten company organization structure, placed functions of finance, accounting and auditing under centralized administration of the vice president-finance. Effect will be to have company treasurer, assistant treasurer-controller and general auditor report to the vice president-finance instead of to the president as in past.

First Lockheed C-130 Hercules for Marines was delivered to Patuxent River, Md., for suitability testing.

Convair-Astronautics will begin shifting operations of its Atlas intercontinental ballistic missile project to a new $40 million plant on the outskirts of San Diego this week. Transfer is scheduled to be completed by January. The missile has been in pilot production at Convair's San Diego facility. The new plant also will house Convair's Scientific Research Department and will be equipped for explorations in gas dynamics, aerodynamics, theoretical and experimental physics, physical chemistry, mathematics, and metallury.

USAF has contracted for an additional 18 C-123 assault and logistics transports with Fairchild Aircraft Division for transfer to the Mutual Defense Assistance Program. The order will carry production of the aircraft through 1958 and bring the total number produced to approximately 300.

COMPARATIVE PRICE INDEXES SINCE 1938 (1949 = 100)



COST RISING, yield per passenger-mile declining is recent domestic trend, as shown above.

Domestic Line Profits May Shrink 50%

Aviation Week survey indicates domestic industry may face sharpest profit decline in history.

By L. L. Doty

Washington—Airline net earnings, following the consistent downward trend that has caused a sharp profit decline in every quarter since 1955, now appear headed for the biggest single-year shrinkage in history.

An AVIATION WEEK survey of domestic airline activity during the first five months of 1957 indicates that industry net incomes for the year may be sliced by as much as 50% (AW May 13, p. 39).

Continued increase in total revenues will again reach an all-time high to maintain the healthy growth pattern of the airlines, but the rise has been rapidly outstripped by mounting expenses. Furthermore, traffic growth has not kept pace with the approximate 20% increase in seat capacity during the past 12 months, resulting in a depression of passenger load factors.

Equipment Reappraisal

Some airline officials warn that, if the trend is allowed to continue, many airlines may be forced to reappraise their financing programs for the purchase of turbojet and turboprop equipment. They point to Capital Airlines' lack of success in disposing of its surplus Lockheed 049 Constellations (AW June 24, p. 42) and say carriers will be forced to dig deeper into capital surplus to pay for the jet equipment if funds from the sale of piston engine aircraft do not materialize as anticipated in original finance planning.

Immediate relief, they say, can come from Civil Aeronautics Board approval of the petition by seven airlines for a 6% passenger fare increase. Hearings in the Suspended Passenger Fare Case have ended and briefs are due Wednesday.

Profit Decline

C. E. Woolman, president of Delta Air Lines, told AVIATION WEEK that the request for a "modest" 6% increase in fares "may help to restore some measure of confidence in the public's evaluation of the airlines as to investment." He added:

"A reasonable earnings record is vital to the attraction of equity capital and other forms of financing, all of which will have to be used in meeting the financial responsibilities incident to the jet age."

The profit squeeze first became evident in 1956 when annual operating income plummeted from $123.4 million in 1955 to $98 million in 1956. At the same time, the profit margin or net operating profit as a percent of total operating revenues for domestic trunk operations dipped to 3.46% as of March 1957 from 5.5% as of March 1956. In 1955, the profit margin was 6%.

Only National Airlines and Eastern Air Lines reversed the industry trend by reporting a stronger 1956 profit margin than was recorded in 1955.

Rate of return on investment—net income before interest and after surplus adjustments as a percent of total investment—showed a similar trend although National, Western, Delta and United showed an improvement in 1956.

Costs per ton-mile have climbed consistently from a low in 1952, as contrasted to a steady decline since that year in passenger yield per passenger-mile, to help tighten the overall profit squeeze. According to a CAB report, passenger yield in 1956 was 5.30 cents as compared with a 5.18 cents yield in 1938. Rail passenger revenue yield per passenger mile for first class travel was 3.39 cents in 1956 as compared with a 1938 yield of 2.07 cents.

Most airline officials agree with Woolman that the 6% fare increase is too "modest" a boost to align passenger

revenue yield in proper proportion to the rising expense level.

TWA President Carter Burgess points out that costs would continue to run ahead of revenues even with a 6% increase and warned that without some relief "the unwelcome prospect of government subsidy, which the airlines rejected several years ago, may return."

TWA's net loss for the first four months of 1957 amounted to $2,991,359.

Smith Warning

In announcing net earnings of $5.7 million for the six months ending June 30, C. R. Smith, president of American Airlines, said that "in spite of an increase of $11.7 million in revenues, the net earnings were $4 million less than the corresponding period of last year." He added:

"There is no indication that the continually increasing costs will ever revert to the level which existed when present airline fares were established 15 years ago."

American Airlines revenues for the six months period were $152 million, an increase of 8.3% over the $140 million reported for the same period of 1956. Total expenses, however, climbed from $130 million in 1956 to $146 million in 1957.

Braniff Airways operating revenues during the first five months of 1957 rose to $21.2 million from $18.2 million earned in the first five months of 1956, but operating expenses climbed 21.2% and net operating profit dropped 37.5% and net surplus declined 53%.

Revenue passengers carried by Capital Airlines during the first four months of 1957 showed a spectacular climb to 1.1 million passengers from 834,000 for the same period in 1956.

Revenues Climb

The airline's revenue-miles rose from 10.3 million to about 17 million during the same period and operating revenues jumped from $16.7 million to $26.8 million.

Capital's expense level followed the industry trend, but the increased revenues were sufficient to offset the rise in expenses, enabling the airline to reverse the general trend and slice its operating loss by almost one-half. However, heavy interest expense covering the Vickers Viscount purchase burgeoned from $204,000 during the first four months of 1956 to approximately $1.3 million during the first four months which ended April 30 of 1957 to increase the company's net loss for the period.

According to CAB's quarterly report of air carrier financial statistics, Capital's breakeven load factor showed a sharp climb during 1956 to pass above the airline's actual load factor—which has also been moving steadily upward—in about June of last year. The report also showed a sharp decline in TWA's actual load factor coupled with a climb in the breakeven load factor that began in the spring of 1955 for domestic operations.

Breakeven Load Factor

Breakeven load factor for the domestic trunk industry showed a slight but significant rise during 1956 and, although a comfortable gap between the breakeven and actual load factors was maintained in 1956, actual load factors leveled off slowly and appeared to be slanted downward during the first five months of 1957.

This trend is evidence of rising costs resulting from the increased capacity that is outpacing increases in passenger traffic.

Operating expenses of Northeast Airlines almost doubled during the first five months of 1957, due primarily to costs of implementing its recently awarded New York-Florida route (AW Aug. 20, p. 38). Revenues rose only slightly during the same period since the airline has not yet been able to invade the market fully and a loss of $1.3 million for the period was reported compared to a loss of $360,000 for the same period in 1956.

United Air Lines dropped from a $4.2 million operating profit for the first five months of 1956 to a $1.2 million loss in the same period of 1957, a 128.3% decline. Revenues were up 5.3% while expenses rose 11.1%. The airline showed a net profit of $656,260 for the period because of a $2,039,000 gain from the sale of aircraft during the period.

Northwest Loss

Northwest Airlines showed a $451,000 loss for the first five months of 1957 as compared with a $290,000 net profit during the same period of the previous year. The airline fell short of its budget which called for a $442,000 profit and revenues of $31 million. Actual revenues were $30 million. Expense-wise, Northwest held close to its budget of $31,152,000 with operating expenses of $31,176,000.

For the first six months of the year, Delta Air Lines reported operating revenues of $42.6 million, an increase of 16.8% over the same period in 1956. But operating profit declined 20.71% to $3.9 million, while revenue passenger-miles increased 18.43%. The airline's operating ratio rose 5.9% from 86.33% in 1956 to 90.72% this year.

Onassis Buys DC-8s

Monte Carlo—Olympic Airways has ordered two Douglas DC-8s at a cost of $12 million and has optioned a third. Order was placed through Ionian Ltd. on behalf of Aristotle Onassis.

The jetliners are scheduled for use on Olympic Airways international routes in 1960.

CAB Orders Military To Abide by CAB Rule

Washington—Airspace conflict between the airlines and the Air Force over airways west of Phoenix came to a head last week when the Civil Aeronautics Board ordered the military to observe Civil Aeronautics Administration air traffic rules in the area (AW May 27, p. 40).

In the first directive of its kind, issued in the form of a special civil air regulation, the CAB directed the Air Force to comply with regulations administered by the CAA that would permit civil aircraft to takeoff at Phoenix without interference from military jet aircraft. Legally, the CAB promulgates and the CAA administers all traffic regulations governing military, commercial, civil and foreign aircraft in the U.S.

The hassle between the airlines and the Air Force first began when airlines complained that use of Green Airway No. 5 and Victor Airway No. 16 were blocked by jet traffic penetration out of Luke Field located directly west of the commercial airport that serves Phoenix.

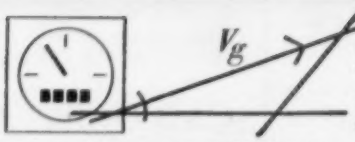
Airlines protested that a gunnery training area overlies the civil airways and has forced aircraft taking off westbound to reach altitudes of above 4,000 ft. within eight miles of the Phoenix Sky Harbor runway threshold to avoid military activities.

Later, the Air Force said steps had been taken establishing caution areas to encompass the Luke Field training area, exit and entry corridors and cautioned that "the probability of mid-air collision is high."

The airlines accused the Air Force of creating the problem through the operation of aircraft from Luke Field and suggested that jet flights in the area be discontinued pending a solution of the problem.

CAA appealed to the CAB to take action on grounds that a "grave safety hazard" in the area exists. The CAB termed the situation an emergency that called for immediate action although comments by interested parties will be accepted until Sept. 16.

Under the unprecedented action, the military will be required to conform with the CAA air traffic rules in the Luke Field area without resorting to its own authority to deviate from the regulations.



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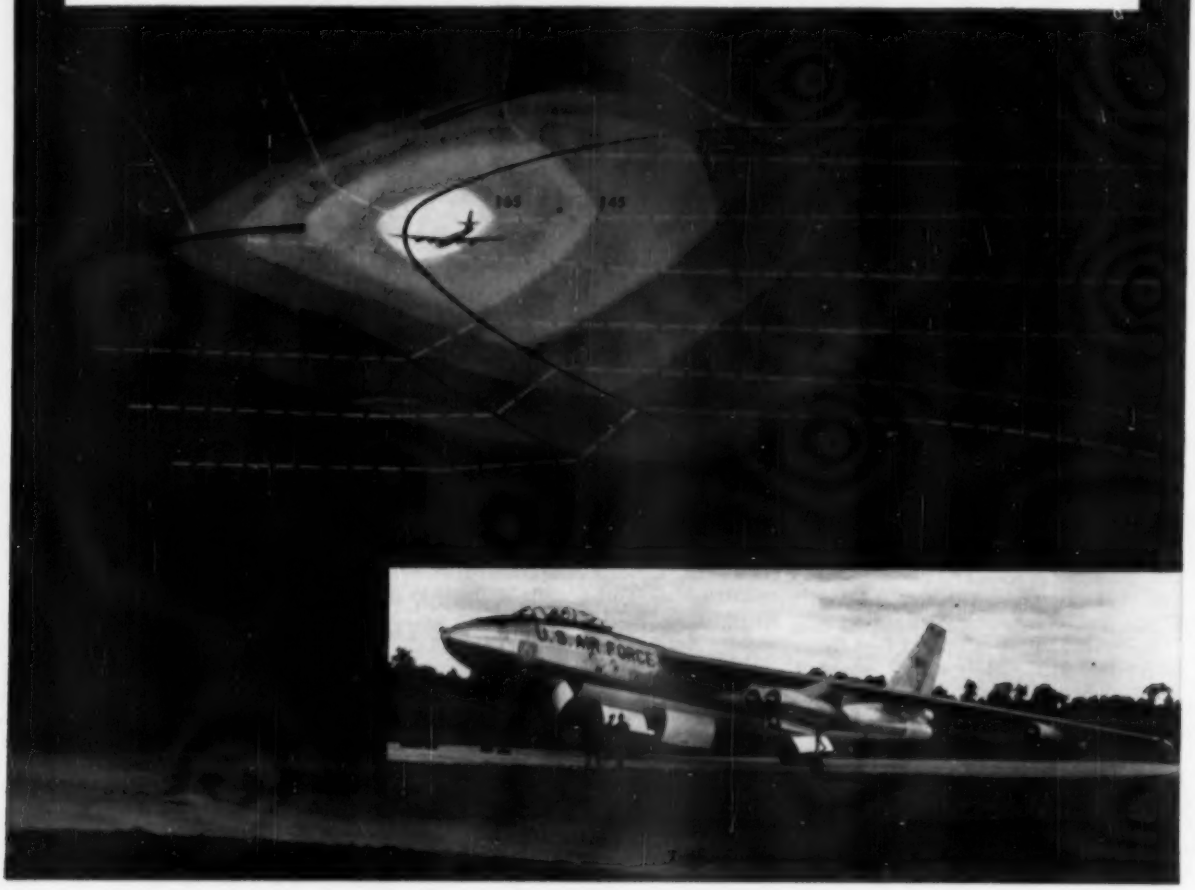

Cross-section of a headline

On January 25, 1957, in the early hours of a California morning, a USAF B-47 climbed skyward into the jet stream. With the aid of one of GPL's self-contained, airborne navigation systems, AN/APN-66, the crew put the plane into a 165 mph-plus jet stream core and held it there all the way across the country. 3 hours, 47 minutes later, the same "47" touched down within sight of the Atlantic Ocean.

The story made headlines and so did the part played by the GPL equipment.

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AFA MEETINGS
July 30—August 3

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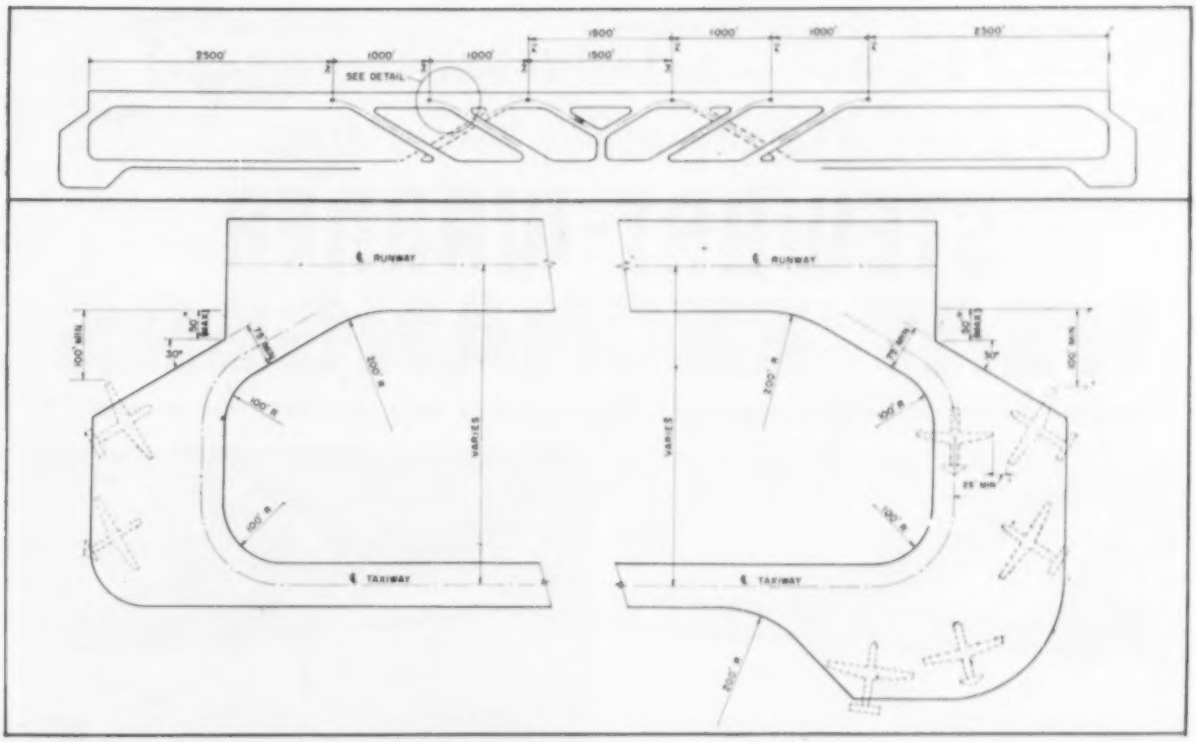

HIGH-SPEED runway exits (top, above), holding apron design (bottom, above) are proposed by CAA.

Runway Plans Designed to Speed Traffic

Washington—Civil Aeronautics Administration is proposing new runway and exit taxiway standards for airports (AW June 15, p. 47) in a move to increase the acceptance rate of air traffic through more rapid clearance of runways.

Proposed standards are based on tests that show transport aircraft can be turned off runways at speeds up to 40 mph. within a radius of 550 ft. without overstressing aircraft or causing uneasiness to passengers.

Conclusions reached by the CAA as a result of its surveys, tests and analysis of landing aircraft and the runway turn-off problem include:

• **Location of exits.** CAA found that approach speeds of large propeller driven aircraft vary from 130 to 150 mph., while touchdown speeds average about 110 mph. To decelerate to 40 mph. using wheel brakes or flaps, requires from 1,300 to 2,500 ft. from the point of touchdown. Most touchdowns occur between 500 ft. from the threshold to about 1,500 ft., the CAA found. As a result, optimum locations for runway exits are set at 2,500 and 3,500 ft. for all normal landings and 4,500 ft. from the threshold to accommodate landings involving unusually long flareouts.

For jet airliner performance, a fourth exit approximately 6,000 ft. from the runway is tentatively recommended by the CAA pending further information on landing performance of the jets.

• **Exit taxiways** should be oriented to a 30 degree angle with a turning radius of 550 ft. on a runway 150 ft. wide. If turnoff speeds of less than 40 mph. are anticipated, the angle may be increased.

However, the CAA warns that exits designed to speed removal of aircraft from the runways should never be placed at an angle to the runway sharper than 45 degrees.

• **Positive identification** of runway exits must be provided if turns are to be made at high velocities, the CAA said. It added that markers must be placed far enough ahead of the exit to give warning to the pilot, and the throat and edge of the exit must be marked so that the path of the aircraft can be directed to and along the exit taxiway.

The CAA concluded that exit taxiways should be tangent sections, faired into the runway edge by simple fillets.

With respect to the holding aprons, the CAA suggested a design that would accommodate two or four aircraft. It added that separation between holding spaces will vary according to the aircraft to be accommodated and probably will range from 150-ft. to 250-ft.

The CAA said the holding apron should be located so that aircraft may enter the runway with a rolling start for takeoff and be required to negotiate only an easy turn to get in line with the runway centerline.

Bypass routes should be provided, the CAA reported, and aircraft positions should be arranged to permit random dispatching of aircraft to prevent bottlenecks caused by delay or aircraft breakdown. The report was issued by the CAA as Airport Engineering Bulletin No. 6.

$6 Million Expansion Planned at San Jose

San Jose, Calif.—Voters have approved a $3.5 million bond issue to pay the local share of a $6 million expansion program for San Jose Municipal Airport. When the program is completed in an estimated five to six years, the field will be designated a coterminal with San Francisco International Airport.

Federal funds will be sought to meet most remaining cost of the expansion.

Plans include a new $600,000 terminal building and lengthening of the present 4,500-ft. runway to 6,000 ft.

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TWA, Pan American Receive Polar Routes

Washington—Trans World Airlines and Pan American World Airways last week were granted polar route authorizations by President Eisenhower and Civil Aeronautics Board to become the first American carriers certificated to operate over the Great Circle Arctic route.

Scandinavian Airlines System has been operating the Los Angeles-Copenhagen polar route for over two years and last March opened a Copenhagen-Tokyo service via the North Pole (AW March 4, 1957).

Both TWA and Pan American were granted Los Angeles and San Francisco as coterminals on the new U.S. polar route. Seattle and Portland were added to Pan American's certificate but only for a temporary period expiring July 4, 1959.

The award of the polar route to the two airlines was granted, CAB said, in view of the substantial volume of California-European traffic, the rapid development of the West Coast area and the benefits accruing to travelers by bypassing the New York gateway.

The Board also found that the volume of transatlantic traffic from the Pacific Northwest is insufficient to support polar route service by two carriers but that an outlet to such service is warranted because of the size and importance of the Northwest area.

Route to St. Louis Proposed for National

Washington—National Airlines last week was recommended for a new route extension to St. Louis via Atlanta and Nashville by Civil Aeronautics Board Examiner William J. Madden. If granted, the proposed route would give National its first direct link with the Midwest and its only inland route.

In his initial decision in the St. Louis-Southeast Service Case, Madden also recommended a certificate amendment to permit Eastern Air Lines to operate between St. Louis and Memphis and an amendment to extend Delta Air Lines Route 24 from Birmingham to Memphis. He also proposed an amendment of Eastern's Route 5 certificate to extend the route from Chattanooga to Birmingham.

Under Madden's recommendations, all other applications for route adjustments in the case including those from Braniff, Trans American Airlines and Trans World would be denied.

Madden chose National for the major route extension in order to strengthen its route structure and to prevent it being "frozen in its present pattern."

AIRLINE OBSERVER

► Airline no-show control plan is not expected to cause an undue strain on present reservations and ticket counter facilities until Phase III of the plan—the no-show $3 penalty—is introduced. Minimum ticket pick-up time, introduced last September added no workload but helped remove pressure at airport ticket counters by increasing ticket sales at downtown offices. Reconfirmation ruling which went into effect last week is re-introduction of a previous system and called for no new techniques in passenger-handling. Most airlines, however, feel that the $3 penalty plan, to become effective on Sept. 15, will call for more personnel, new techniques and more electronic systems to cope with increased telephone and ticket sales activities expected to result from the penalty feature.

► Trans World Airlines offering of 5,337,036 shares of common stock on a one-for-one basis at $13 per share was fully purchased by the closing date of the offering, July 8, for total proceeds of $43,381,468. Stockholders, other than Hughes Tool Co., subscribed to 644,977 shares. The remainder of the issue was acquired by the Hughes Tool Co.

► Eastern Airlines motion to dismiss charges by the Civil Aeronautics Board that the carrier has oversold flights illegally has been denied. The Board also denied an Eastern Airlines request for a prehearing conference in the enforcement case but has ordered its Office of Compliance to furnish the airline with a bill of particulars. Eastern has protested that the charges are "vague, indefinite and ambiguous" and any overbookings have been the result of clerical errors or time lag.

► Allegheny Airlines has extended the family fare plan to include Saturdays following a Civil Aeronautics Board dismissal of a request by United Air Lines for suspension of the proposed reduced fare. American Airlines issued a statement in support of the United complaint. However, the Board ordered an investigation of the proposal but ruled it would be inequitable to suspend the Allegheny proposal since both Northwest and Capital Airlines (AW April 22, p. 14) are offering the reduced fare on Saturdays in competitive areas served by Allegheny.

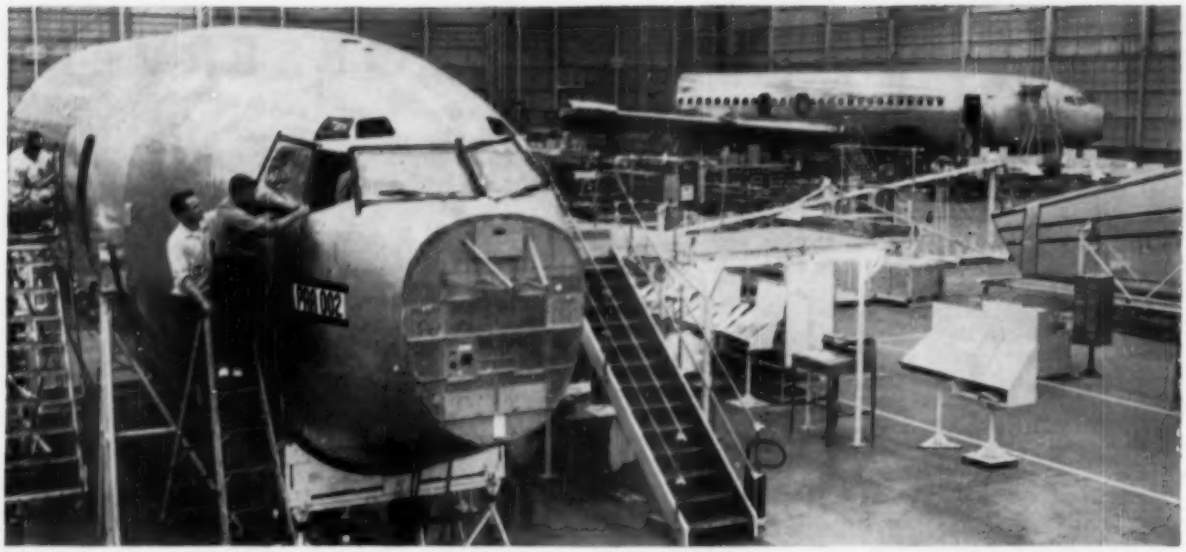
► Braniff Airways current final mail rates for its international routes will be reopened by the Civil Aeronautics Board in a move to determine whether the airline's subsidy requirements may have diminished. Subsidy paid the carrier during the 12 months ended March 31 amounted to $1,037,000 and the CAB pointed out that profits for the period on international operations totaled $672,000 for a 28.7% return on investment. The Board ordinarily prescribes a 9% rate of return for international routes.

► National Airlines clerical and agent personnel will conduct a strike vote next week in a labor dispute involving demands for wage increases retroactive to April 1 and a full union shop. Air Line Agents Assn. represents the 1,700 clerks, agents and reservationists.

► Delta and Eastern Airlines have been ordered to cease and desist from certain advertising practices following complaints by each of the two carriers against the other of allegedly engaging in unfair and deceptive practices. The Civil Aeronautics Board resolved the case through its informal conference procedure. Delta has been ordered to stop such advertising as "Delta DC-7's World Fastest Airliners" or "Only Delta offers nonstop DC-7 service to so many cities." Eastern has been ordered to refrain from using such phrases as "lowest scheduled fares" and "fastest service."

► Port of New York Authority and airlines using Newark Airport have reached a tentative agreement on plans for a new air cargo terminal at the field. Proposed design calls for a building of 96,000 sq. ft. Newark now handles about one-third of New York's domestic cargo traffic.

► Port of Portland (Oregon) commission has asked for a formal hearing before the Airport Use Panel of the Air Coordinating Committee on the problem of Air Force interceptor activities at Portland International Airport.



FUSELAGE for second Pan American Airways Boeing 707 is assembled (foreground) as first airplane adds wing structure (background).

Boeing Plans Short-Range Jet Designed for 130 Passengers

Seattle—Details of the short-range Boeing 717 turbojet transport designed to carry 130 passengers over 200 to 1,700 mile stage lengths at speeds of up to 600 mph. were released for the first time last week.

The turbojet transport, third in the series of jet airliners proposed by Boeing Aircraft Corp., will be identical in design to the 707 Stratoliner designed for medium to long-range operations and the 707 Intercontinental designed for very-long range flights. A total of 151 707s of both types are on order by 13 airlines.

No price has been set on the smaller 717, but it is being offered in the transport market with a mid-1960 delivery date. Boeing officials here declined to comment on whether firm orders for the short-range jet have been received, but it is believed that release of the performance figures coincide with renewed interest for a short-range jet transport by at least one U. S. trunkline.

Performance Details

Here are the performance details and specifications of the new transport:

• **External dimensions of the 717** and 707-120 are identical. Wingspan is 130 ft., 10 in., fuselage is 128 ft., 10 in., and tail height is 38.7 ft. Wing sweepback will be 35 degrees at 25% chord. Chief difference between the two aircraft lies in maximum gross weight. The 707-120 weighs 247,000 lb. at takeoff, but the 717 will weigh only 185,000 lb. Lower gross weight of the 717 has been accomplished by the lighter structure and smaller fuel load compatible with the shorter range of the aircraft.

• **Aircraft will be powered** by four Pratt & Whitney advanced JT3 engines although engines such as the General Electric advanced J79 and others in this power class may be used. Cruising speed of the aircraft has been set at 550 to 600 mph.; cruising altitude will range from 25,000 ft. to 40,000 ft.

• **Range with a maximum payload** will be 1,700 miles and with a full passenger payload, 2,400 miles. Design payload 32,500 lb.

With a standard configuration, the aircraft will carry 88 passengers; with a tourist seating arrangement, 130 passengers.

• **Fuel capacity** is 10,092 gallons; gross weight, 185,000 lb.

In announcing the details of the short-range jet, J. B. Connelly, vice president and general manager of Boeing's Transport Division, said, the "717 will not be a completely new design . . . and will be built at the Transport Division's Renton, Wash. plant on the same production jigs and tools and on the same production line as the 707 series, thus making possible interchangeability of parts and common spares for the three airplane types."

He added:

"It is our intention to provide an airliner which will operate economically over all short-to-medium range segments of world-wide routes."

Boeing officials said the 717 will be capable of takeoffs and landings on runways presently available at the major and intermediate airports of the world. They said Civil Air Regulations' field length required for full gross takeoff weight will be 5,400 ft. with dry power ratings.

Landings at 150,000 lb. will require a CAR field length of 5,500-ft.

Connelly said the interior furnishings of the 717 will be interchangeable with those of the 707 Stratoliner and 707 Intercontinental. He added that this would permit a wide variety of seating arrangements and include the convenience and economy of washable, easily replaceable interior wall panels, track-mounted seats and bulkheads.

SHORTLINES

► **Trans World Airlines** will begin nonstop Lockheed 1649A Constellation service from Boston to Los Angeles on August 17. The new service is scheduled to leave Boston's Logan Airport daily at noon EDT and arrive at Los Angeles International Airport at approximately 6:45 p.m. PDT. Trans World will begin 1649A international service from Boston on Aug. 2 with a flight departing from Logan Airport every Friday on the route to Lisbon, Madrid and Rome. TWA is scheduling 18 flights a week between Boston and Europe and 22 flights daily between Boston and the West on its domestic routes.

► **Chicago Helicopter Airways** flew 5,405 passengers in June, an increase of 45% over May (AW June 17, p. 41). The line reports that 3,499 passengers were carried between O'Hare and Midway airports—1,061 between Midway

and the Chicago Loop and 845 between Chicago Loop and O'Hare.

▶ **Flying Tiger Line** had gross revenues of $6,094,444 for the two month period of May and June, a 79% increase over the same period of last year. The May revenues were $2,899,866; June revenues, $3,194,578. The June figure is a new monthly record for the carrier, the first time its total traffic has exceeded the $3 million level. The line flew 7,069,641 ton-miles in May, the first time it has exceeded the seven million mark in a month.

▶ **Seaboard & Western Airlines** reports a 42% increase in transatlantic air freight traffic for the first six months of 1957. The carrier flew 5,192,197 ton-miles as compared with 3,654,232 during the first half of 1956.

▶ **International Air Transport Assn.** has admitted two additional British Airlines to IATA membership. Eagle Airways Ltd. and Skyways Ltd., both of London, are the 69th and 70th members, bringing the British airline membership total to six.

▶ **Port of New York Authority** has postponed the July 31 dedication of the new $120 million "Terminal City" development at New York International Airport. The Port Authority took the postponement action because of an unsolved jurisdictional dispute between the Assn. of Bridge, Structural and Ornamental Iron Workers and the Sheet Metal Workers International Assn. coupled with the current strike of the sheet metal workers and the steam fitters which has tied up all finishing trades working in the building. The Port Authority has said it will announce a new dedication date soon.

▶ **Trans-Texas Airways** registered an all time high load factor of 46.01% during June. The airline had two other monthly records; number of passenger boardings, 21,718, up 8.72% over June, 1956; and passenger-miles which rose 14.10% over last year to 5,198,808.

▶ **United Air Lines** flew 493,752,000 revenue passenger-miles in June to set a new system record. New June records were established in mail traffic, 2,377,000, ton-miles, up 7% over last June, and freight, 5,327,000 ton-miles, up 25% over last year.

▶ **Pan American World Airways** Atlantic Division carried 169,840 lb. of cargo during the two week period ending July 6 for a new division record. The carriers' 77 weekly passenger-cargo and six weekly all-cargo flights made the record haul.

Zero-Zero Landings—I

From shortly after midnight until daybreak on the morning of April 26 the weather reports from Andrews Air Force Base said WOXOF—teletype language for "Ceiling indefinite zero, obscured visibility zero, fog." During these hours about 25 successful instrument approaches were made at Andrews. About half were made by a CAA DC-3, Captain Robert Gates in command, the balance by an American Airlines Convair on which I was listed as Captain.

These were not the first zero-zero operations in history, although I do not recall any others in which visual aids and aircraft radios were the only facilities used. The ease of these flights indicates that our goal of all weather operations is not as remote as formerly believed. The "hows" and "whys" behind these flights appear of sufficient importance to warrant telling the story in detail. My next several columns will tell this tale.

Visual Guidance Needed

The need for visual guidance on low approaches has long been recognized. And this guidance must be continuous from about the middle marker on the ILS all the way to the terminal parking area. As pointed out in this space on many occasions, the ALPA-ATA centerline approach lights, equipped with condenser discharge flashers, are the first link in the system. After many years of debate and testing, this configuration is at last finding its way into general use.

One of the most important factors in a visual aid system is balance. That is, both the approach and runway areas must provide identical levels of brightness in order to prevent blinding. Our centerline system provides an acceptable amount of light in the approach area.

Now the problem is on the runway. Wide runways—on the order of 200 to 300 feet—are extremely difficult to illuminate. Furthermore there are certain peculiarities in the eyes of the landing pilot (AW April 30, 1956, p. 45) which require some guidance down the center of the runway. Painted markings fail on this score since paint does not show up well enough under many conditions and is soon obliterated on heavily traveled runways by oil and scuff marks.

The first attempt to illuminate, rather than paint, the middle of the runway was a system devised in Holland. It consisted of a dual row of lights embedded in the pavement—one on either side of the center of the runway. This arrangement showed enough promise to warrant trying in the U. S. In a fine example of cooperation, the USAF, the CAA, several airlines and airline pilots pitched in on a flight program to test the system. The CAA Administrator Jim Pyle rated lighting with enough priority to appoint Bob Gates as a special lighting coordinator. This interest was matched by the USAF which donated an unused runway at Andrews Field and by several airlines which provided aircraft for test flying.

Testing at Andrews

Over at Andrews a complete ILS and centerline approach light system was set up. On Runway 28 several different lighting configurations were installed. We were interested in how far apart the "narrow gauge" runway lights should be—60 or 75 or 90 feet? We also wanted to know about the longitudinal spacing, should it be 100 or 200 feet?

Additionally, there was some new flood lighting for the edges of the runway developed by Sylvania and this also was tested. Nearly any combination of lights was available by a ground switching arrangement. Next time out I will discuss some of the results.

More about Bristol's "Whispering Giant" - world's largest, fastest, quietest, jet-prop airliner

INTER-CITY.....

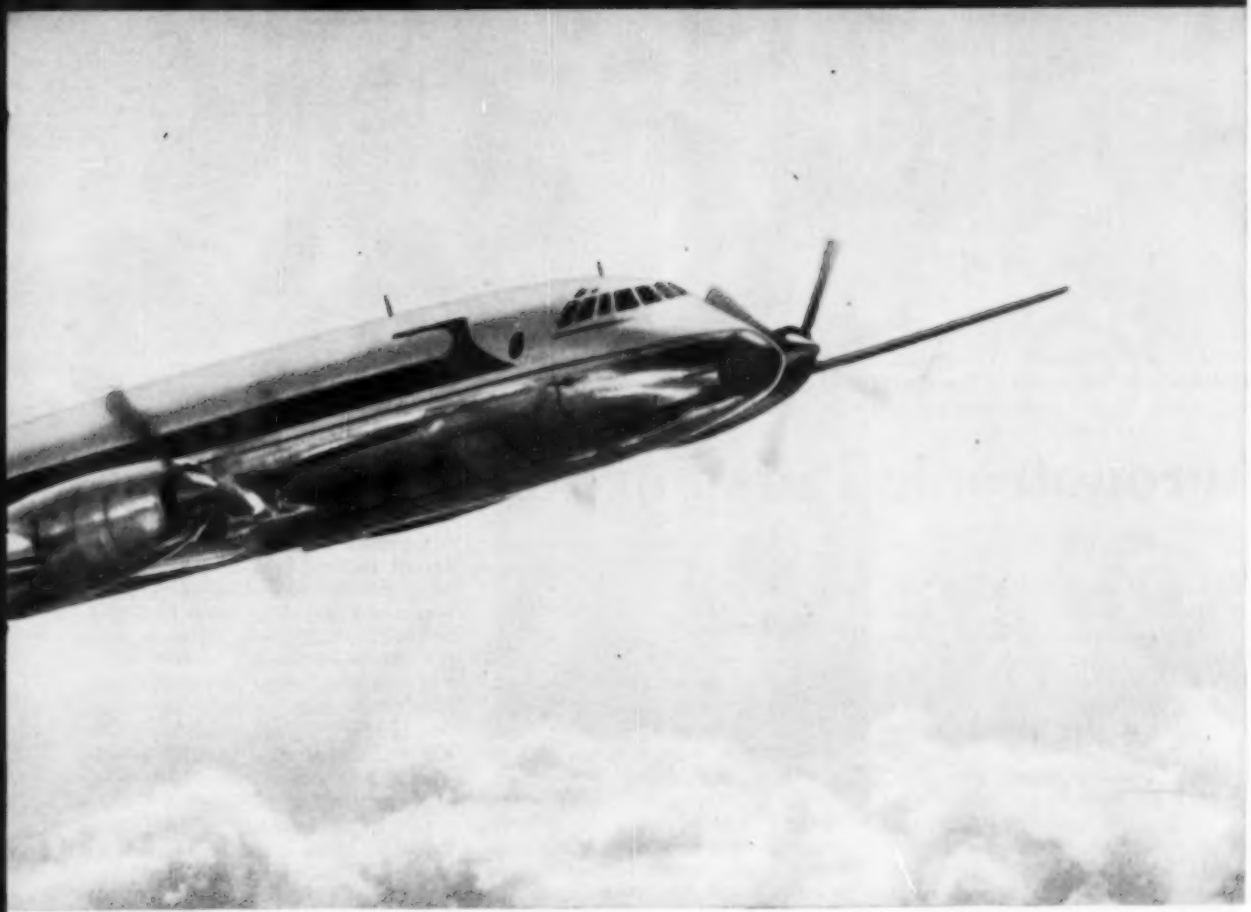
Inter-city or trans-polar... only the Britannia is a money-maker on such a vast variety of routes

HERE is an airliner ideally suited to almost any stage-length . . . short or medium or long. Here is the only airliner that makes money in so many different ways . . . on inter-city, trans-continental, or even the longest trans-oceanic flights.

This is an airliner that outperforms all other passenger aircraft in service . . . the new Bristol Britannia . . . world's largest, fastest, quietest, jet-prop transport. Her record shows her to be the most versatile airliner ever to fly. She has no noise, runway or traffic-control problems. Her remarkable flexibility allows her to use existing traffic patterns and runways almost anywhere in the world.

Operators have already chosen Britannias for an amazing variety of stage-lengths, from short 200-mile inter-city routes to long 4,500-mile trans-polar flights

. TRANS-POLAR



Britannias will be flown between New York—Washington and New York—Miami by Northeast; between Havana—New York by Cubana De Aviacion and between Mexico City—New York by Aeronaves De Mexico. The same type of aircraft will be flown nonstop across the Atlantic by BOAC and El Al, and on trans-polar and trans-Pacific routes by Canadian Pacific.

Powered by four 4120 h.p. Bristol Proteus turboprop engines, the "Whispering Giant" cruises at 400 m.p.h., carries up to 133 passengers and cuts operating expenses to a new low.

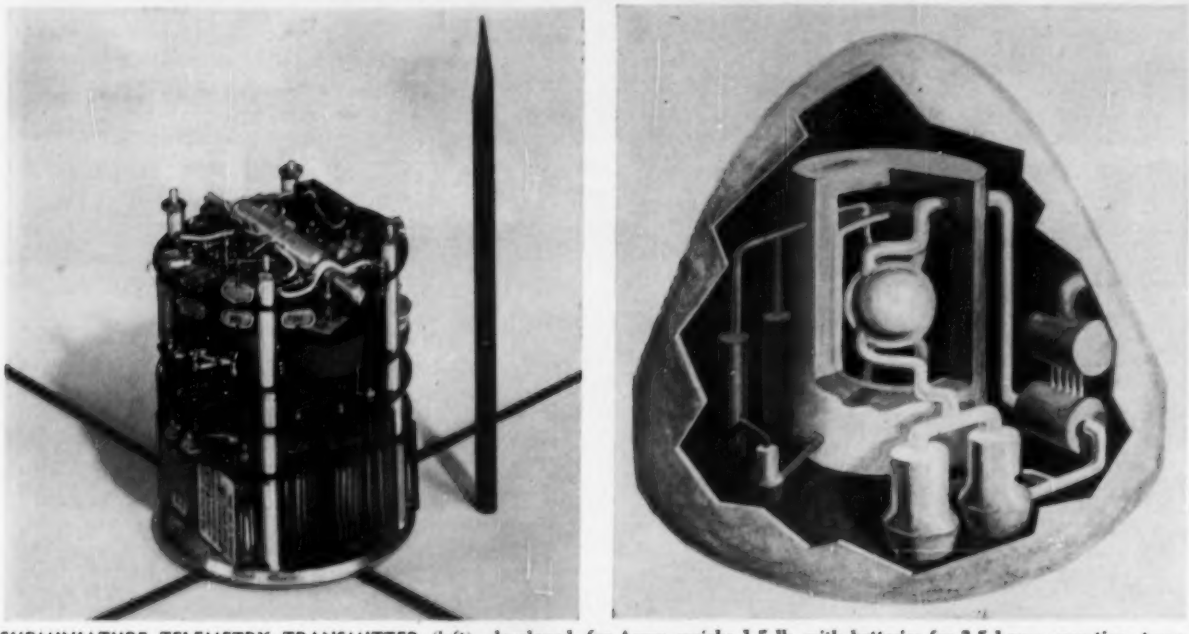
World-wide recognition and demand:

Britannias are in service on BOAC routes spanning four continents and have been ordered by Aeronaves De Mexico, Canadian Pacific, Cubana De Aviacion, El Al Israel Airlines, Hunting-Clan Air Transport, Northeast Airlines, the Royal Air Force and the British Ministry of Supply.

BRISTOL

Britannia

Bristol Aircraft Limited • England



SUBMINIATURE TELEMETRY TRANSMITTER (left), developed for Army, weighs 1.5 lb. with batteries for 2.5 hours operation, transmits .5 watts. Another Aeronutronic project is heavy water homogenous nuclear reactor. High flux test reactor has seven 6 in. test loops.

Aeronutronic Puts Ford in Missile Field

By Irving Stone

Glendale, Calif.—Only a year old, Aeronutronic Systems, Inc., a Ford Motor Co. subsidiary, is firmly establishing itself in the missile field.

Skills of its team of scientists and engineers encompass extensive fields of technology including broad categories of aeronautics, nucleonics and physics, electronics and computers. This gives an ability for an across-the-board missile coverage ranging from concept through research, development-engineering and test, while the company can draw on Ford's extensive resources and personnel for production capability.

Areas of Interest

ASI's spheres of overall product interest embrace both military and commercial aspects but present emphasis is in the military area with accent on:

- **Ballistic missiles.**
- **Anti-ballistic missile missiles.**
- **Surveillance systems.**
- **Atmospheric and space research systems.**

Usually, basic step which precedes the conceptual phase in the across-the-board coverage in any of these categories is operational analysis. For a tactical missile the operational analysis establishes basic parameters such as range, bomb yield, speed, guidance type and accuracy, launching and logistic characteristics. In effect, this sets systems requirements.

Missile Proposals

ASI has made numerous studies and proposals for operational ballistic missiles covering ranges of 20 to 10,000 mi.

Several programs for developing advanced weapon systems in this category are now being discussed with the military, based on radically new concepts relating to system simplicity, mobility, launching ease, light weight and flexibility for use against various targets.

Emphasis will shift rapidly to defense against ballistic missiles, ASI believes. Also, it feels that many of the techniques and devices necessary to such an anti-system will be similar to those of the offensive weapons.

Two aspects of the problem different from the ballistic missile and which ASI is now considering, are:

- **Detection of the ballistic missile.** This will be extremely critical because of the high speed involved. A warning period of at least 10 to 15 min. is desirable, hence detection of an intercontinental ballistic missile would have

Ford Motor Co. organized Aeronutronic Systems, Inc., on July 1, 1956 to establish Ford's position in the weapons field as an original design, development and production source. Ford felt that ASI would enhance its mobilization potential and facilitate transition from civilian products to military products, if military requirements would so demand.

Nucleus of ASI was a group of 24 scientists and engineers who had been associated in the missile field as Systems Research Corp. ASI's total personnel now numbers 230. Professional staff totals 132 and of this number 68 have Masters degrees or higher, including 32 PhDs.

In addition to a multi-million dollar program with military and Atomic Energy Commission, under discussion are projects which would total in excess of $100 million.

Temporary quarters are at the terminal facilities of Grand Central Airport in Glendale. New engineering, laboratory and prototype production facilities are planned, probably in 1958.

Key personnel includes: G. J. Lynch, president; Dr. E. H. Krause, vice president, research and development; Dr. M. H. Johnson, head, nucleonics and physics; J. R. Ambrose, head, electronics; Dr. S. D. Wanlass, head, computers; and Dr. J. V. Charyk, head, aeronautics.

to be effected at a substantial distance from target. This would involve not only a sensitive acquisition system but a high speed communication and tracking system to guide the anti-missile missile to its target.

• **Determination of how the nuclear warhead** on the oncoming ballistic missile can be disabled, and what techniques and devices will make kill radius of an anti-missile missile large as possible.

Reconnaissance Vehicles

Important future military operations problem is determining target positions so that modern weapon systems, with all their accuracy, mobility and flexibility, can be brought to bear effectively on them.

This places new emphasis on need for surveillance systems compatible with weapons system capability, in the sense that information generated by the surveillance system must be fast and direct.

For example, if on a battlefield of tomorrow the enemy concentrates his troops and equipment for an amphibious assault, information on location of the concentration is needed in sufficient time so that destructive action can be taken before the move begins. This intelligence must be obtained even though the air is uninhabitable by manned aircraft.

ASI is intensively studying high-speed unmanned vehicles as well as the reconnaissance equipment to get information, data links to send information to home base and data-processing equipment on the ground for handling and translating the data obtained. Reconnaissance sensors will involve optical, infrared and radar devices.

This work is being conducted partly under military contract and partly under ASI's independent efforts.

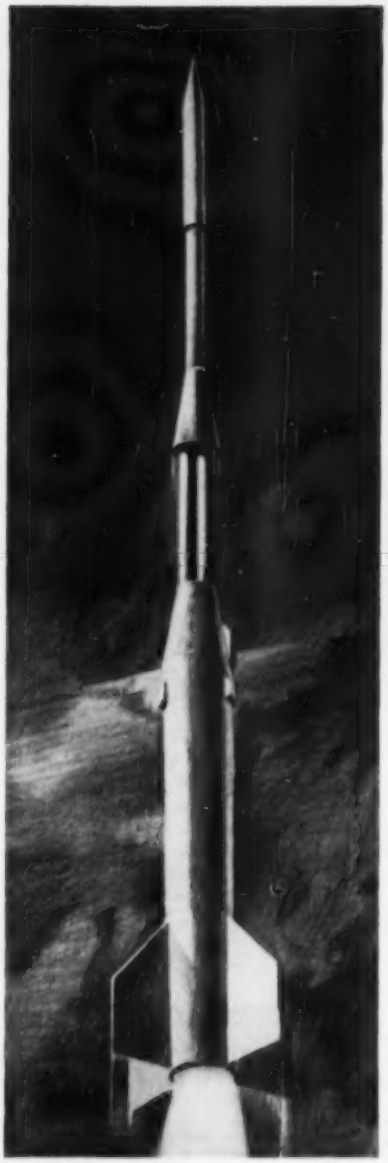
Space Research

ASI's activity in atmospheric and space research systems is directed at development of devices for investigation of natural phenomena in these regions.

This involves development of the vehicle itself, equipment for conducting experiments and a means for transmitting or conveying results of these experiments back to earth.

Multi-stage, solid-propellant vehicles for probing the outer reaches of the atmosphere and well into space are under development at ASI, and prototypes are being fabricated in ASI laboratory shops.

These vehicles will gather data on cosmic ray intensities, magnetic fields, ion densities, solar radiation. Special instrumentation is being devised by ASI to make some of these measure-



RESEARCH ROCKET designed to reach altitudes of several thousand miles will have five stages, weigh 7,400 lb.

ments, because severe weight and power restrictions are involved.

These same restrictions bring problems in communication equipment. ASI is developing special transitorized data links which will permit reliable communication over the long distances involved.

Much of this instrumentation and communication equipment is out of the design stage and is being fabricated in ASI laboratories and shops.

Bulk of atmospheric and space research is being carried out under military contract but some facets are independent efforts because of ASI's interest in this general field.

ASI believes that a systems conceptional, design and production competence can be attained only through a real capability in subsystem supporting areas. To insure a high level of competence in this basic support, ASI has established, so far, four technical laboratories: electronics, nucleonics and physics, computer and aeronautics.

Supersonic Autopilot

Electronic Laboratory is organized principally for research and development of avionics subsystems for missiles and aircraft.

Under development is a self-optimizing autopilot for aircraft. Circuitry would supplement autopilot action by determining the optimum response of the aircraft in a given maneuver or flight pattern. Benefits of this device:

• **Minimizing test time** to determine flight performance.

• **Elimination of manual settings** of autopilot to obtain optimum performance.

These benefits are expected to be of particular value in supersonic aircraft, which now require extensive testing and have very short response times. This project is under an Air Force contract.

For the Signal Corps a broad analytical study is being conducted for requirements and techniques of future telemetry systems and trajectory instrumentation for missiles.

Electronics Laboratory already has built and tested a prototype model of a very long-range, lightweight telemetry transmitter. A flight model of the system is under construction along with a ground-receiving station capable of tracking very low signal levels in the presence of galactic noise.

Studies of advanced inertial and radio guidance systems are being carried out for long-range ballistic missiles. This work mainly is being done under ASI's own cognizance.

Another study concerns reconnaissance sensors, particularly passive devices.

Function generator capable of handling two or more variables is in development. This equipment is expected to have an important application in analog computers, affording solution of problems of greater complexity. While development presently aimed at a laboratory device, it also is expected to have application to airborne computers. Work is supported solely by ASI funds.

Nucleonics and Physics Laboratory essentially is engaged in these theoretical studies, under military contract, relating to nuclear warheads:

• **Effects produced by nuclear detonation** under a wide variety of tactical and strategic situations. This also includes utilization of radiation which

ROCKET-DRIVEN at speeds up to Mach 1.5, a U. S. Air Force sled built and operated by Convair Division of General Dynamics Corporation ejects a dummy identical in size and weight to the pilot of a supersonic plane. Instrumentation developed by Cook Research Laboratories, using G-E 5-Star high-reliability subminiature tubes, measures acceleration as the figure is fired from the sled; wind-blast pressure on the chest; tumbling about three axes; other physical strains.

General Electric 5-Star Tubes help measure stresses on fighter pilots ejected at 1200 mph!

Accurate measurement of the severe pressures pilots undergo when ejected from military jet planes, is the function of advanced equipment designed and built by Cook Research Laboratories, a division of Cook Electric Company, Chicago, Ill. The findings are applied by the U. S. Air Force in improved methods to assure pilot safety.

General Electric 5-Star tubes—used because of their superior resistance to shocks and vibration, plus all-around high reliability—play an important part in the Cook instrumentation and recording system that is carried by dummy pilots fired from a test sled rocket-propelled to supersonic speeds.

In several cases—despite the tremendous speed of the ejected instruments and consequent high ground impact—equipment and tubes have proved to be still operable *after* recovery of the dummy!

The same 5-Star tube ruggedness and extra dependability which Cook employs so successfully, are available to your equipment and circuit designers. Ask for a G-E tube representative to call at your convenience! *Receiving Tube Department, General Electric Company, Owensboro, Kentucky.*

Progress Is Our Most Important Product

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362-1A3

thus far has had no practical military applications.

• **Integration of nuclear warhead** into the missile system. This includes such factors as aerodynamic configuration, heat insulation to withstand reentry conditions, structural blending of airframe and bomb so that warhead might serve as an integral part of the airframe.

Studies already partially initiated are aimed at application of nuclear systems for both ramjets and non-air-breathing missile powerplants.

ASI already has completed a study for Atomic Energy Commission to select type of reactor system most suitable for high-flux testing of fuel elements. Such a high-flux reactor could contribute to the development of advanced nuclear powerplants for aircraft, ships and as an electrical energy source for industry.

Series of studies are under way on reactor types and facilities for maritime applications.

High Altitude Study

In its experimental physics, the laboratory is developing lightweight instruments for measurement of pressure, earth's magnetic field, cosmic rays and atmospheric density at very high altitudes. Some of this instrumentation is for studying physical conditions several thousand miles from the earth.

Under study are means for measurement of infrared background, especially at altitudes above 100,000 ft. This is important in relation to long-range detection of ICBMs and development of infrared seekers for anti-missile missiles.

Another area of ASI interest is magneto-hydrodynamics, behavior of plasmas in a magnetic field. This is significant for an understanding of conditions in the earth's atmosphere above 100 mi. and propulsion possibilities for space vehicles.

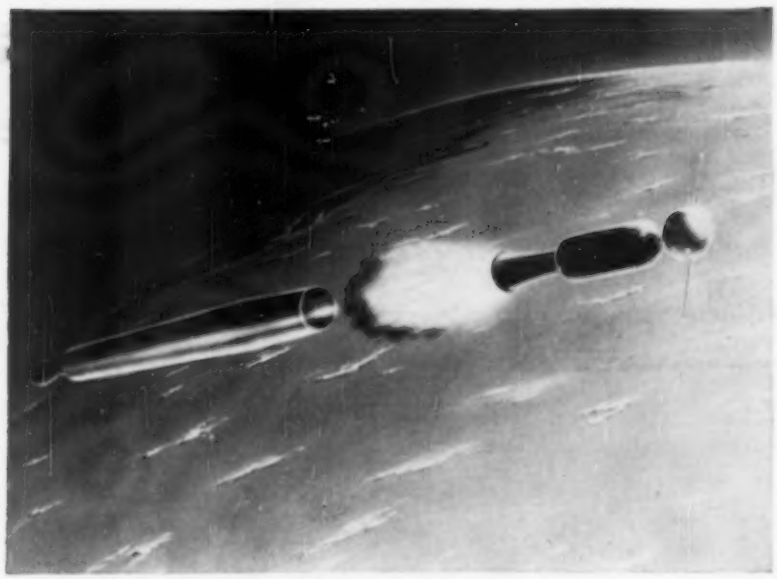
Nucleonics and Physics Laboratory is projecting a research program in properties and materials at high temperature and under intense radiation. Object is to understand underlying mechanisms governing strength and other physical properties of materials, leading to improved materials.

Computer Program

Virtually any missile system today requires several varieties of computers. There is a need for a computer at the launch point to translate target and launch information for the missile. Also, there is a computer within the missile for providing continuing directions required for guidance. ASI is doing computer research and development in both these areas.

One field in which it is working is development of small-size transistorized digital computers to minimize weight, power and cooling requirements.

In present day missile testing, amount and complexity of information contained in a given flight is so great that many days are required to convert data into usable form. ASI is working on methods for reducing data in "real time"—transformation of data into usable form as rapidly as it is received



Satellite Separation

Separation of the third stage of the Vanguard satellite from the second stage is depicted in this drawing by Martin Co. artist. Solid-fuel third stage rocket engine has just begun to fire.

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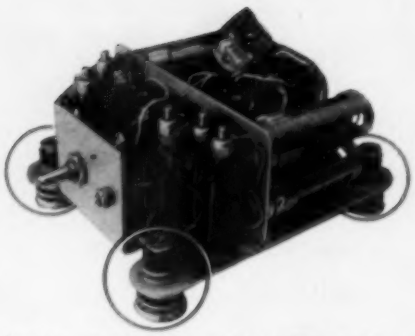
LORD mountings protect vital aircraft electronic equipment



Lord Mounting Base Assembly gives four-point support of Jack & Heintz Inverter Voltage Regulator used in F-100 fire control system. Design objective of the mounting base is the protection of critical regulator sensitivity against severe vibration and gun firing shock.

Protecting vital electronic components from shock and vibration . . . that's the job LORD mountings are doing in countless applications on aircraft—large and small, military and commercial, under all flight conditions and environmental extremes.

LORD mounting systems efficiently control the vibratory disturbances of flight which could damage or cause malfunction of the sensitive equipment they support. With their superior stability, motion of the mounted equipment is minimized and secure installation is assured at all times.

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"In Canada—Railway & Power Engineering Corporation Limited"

LORD MANUFACTURING COMPANY, ERIE, PA.

from the missile. One aim is rapid presentation of selected data to concentrate on one aspect of the missile flight test, if test conditions require this.

Another projected development is the use of a data processing and evaluation device in a surveillance vehicle so that pre-selected types of information are transmitted to the ground to the exclusion of the great mass of overall data which would be obtained during the surveillance flight. An aerial TV camera would map overall terrain data, but only troop movements on highways might be transmitted.

ASI is working on the design of a special purpose digital computer for Ford Motor Co. This device will schedule parts for assembly, control parts inventory, bill and handle other functions. This type of computer could also provide similar functions for aircraft and missile production.

Aeronautic Interests

Aeronautics Laboratory interests embrace aerodynamics, aeromechanics and propulsion.

In the aerodynamic field, study and development work are being done on ballistic missile and glide reentry bodies. One big area of investigation is dissipation of the large amount of kinetic energy reentering bodies have. Problem reduces itself to slowing the body down so that heat generated can be dissipated without consuming the body. ASI studies embrace aerodynamic designs, materials, heat-absorbing and dissipation systems. Related to this are aerochemical problems of the interaction between surface material and the surrounding gases under very high temperatures generated during reentry. Also involved is erosion of surface materials and resulting changes of aerodynamic properties.

ASI has been studying low-density aerodynamics for operational altitudes in excess of 100,000 ft. Prime interest is development of measurement techniques for aerodynamic phenomena.

Aeromechanics studies are in structures and structural dynamics. In the trend toward higher performance vehicles, it is necessary to reduce structural weight to a minimum. This not only requires ingenious structural design and new materials, but also introduces new structural dynamic problem. For example, in many instances the body becomes a very thin flying steel shell subjected to intense aerodynamic forces and heating. Significant number of vibrational modes increases and ability of the structure to withstand disruptive forces is decreased. Heating poses numerous new problems under dynamic loading conditions. New stress-strain relationships and new buckling criteria are involved.

In ASI's Aeronautics Laboratory research and development are proceeding to obtain higher performance liquid, solid and hybrid missile-propulsion systems, with particular emphasis on solid propellants because of advantages they present in systems simplicity, ease of handling and launching and simpler checkout prior to launch. One development is lightweight engine cases, through use of plastics, wire-winding and thin high-strength materials.

With respect to propulsion itself, emphasis is on development of high specific impulse formulations, which have high densities and good temperature characteristics.

Detonation, involved in very-large-grain solid propellant motors, is being studied. This work may determine if a critical size of propellant grain can exist.

Methods of thrust termination for solid propellant rockets also are being investigated. This, perhaps, is the key problem in use of solid propellant motors, especially in conjunction with space travel or satellite vehicles. ASI is exploring different ways in which thrust termination can be achieved and studying form and time of the decay curve. Some schemes for thrust termination under analysis include forms of control by reversal or variation in port area.

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This model, and a host of other aircraft seat designs, have been styled to suit any conceivable plane interior. From upholstery to the fold-away Aerotable, this seat offers your passengers the ultimate in comfort and safe relaxing flight in fancy. Aerotherm seats are the choice of major airlines the world over and their performance is attested to by repeat orders.

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Leakproof, blowoff-proof fittings

Two years of flight experience now stand back of this high temperature 3000 psi hydraulic hose . . . the best proof of reliability.

This hose achievement reaffirms that the Fluoroflex-T patented tube does make a *vital* difference . . . affording corrosion-proof plumbing of highest integrity. The lines have solved the fatigue problems met in many high temperature high pressure applications. Their Resistoflex-designed fittings locked tight to hose give complete assurance against blowoff under severest conditions.

These assemblies are the first to pass the Wright Field high pressure, high temperature hose tests.

VITAL FACTS ABOUT FLUOROFLEX-T

All Fluoroflex-T hose starts with Teflon powder — which is only a *raw material.* It's a known fact that compounding ingredients and the fabricating techniques used with Teflon can vary properties in the end product *substantially.* Therefore, the fabricator's integrity and experience are the user's best assurance of performance and reliability.

Many years of research and testing went into the development of the unique and patented Fluoroflex-T tube. The 3000 psi hose assemblies emphasize anew the conservative policy of Resistoflex in presenting a product. *Long term* testing and *field service* were essential phases in the development. Send for data.

® *Fluoroflex is a Resistoflex trademark. Teflon is a DuPont trademark.*

Originators of high temperature fluorocarbon hose assemblies

Resistoflex

CORPORATION

Roseland, New Jersey • Western Plant: Burbank, Calif. • Southwestern Plant: Dallas, Tex.

CORPORAL LOADER demonstrates ability to carry the missile over rugged terrain as well as highways. Vehicle is diesel-electric.

All-Terrain Vehicle Handles Corporal

Corporal Loaders, all-terrain vehicles, already used by the U. S. Army, are now being built in undisclosed numbers for the British government. British have activated units to use the Firestone missile.

Feature of the vehicle is its all-electric power supply which drives the machine through electric motors geared to each wheel, handles and positions the multi-ton Corporal missile and actuates the vehicle's power steering. Electrical power is supplied by LeTourneau-built generators driven by diesel engines under the hood of the machine.

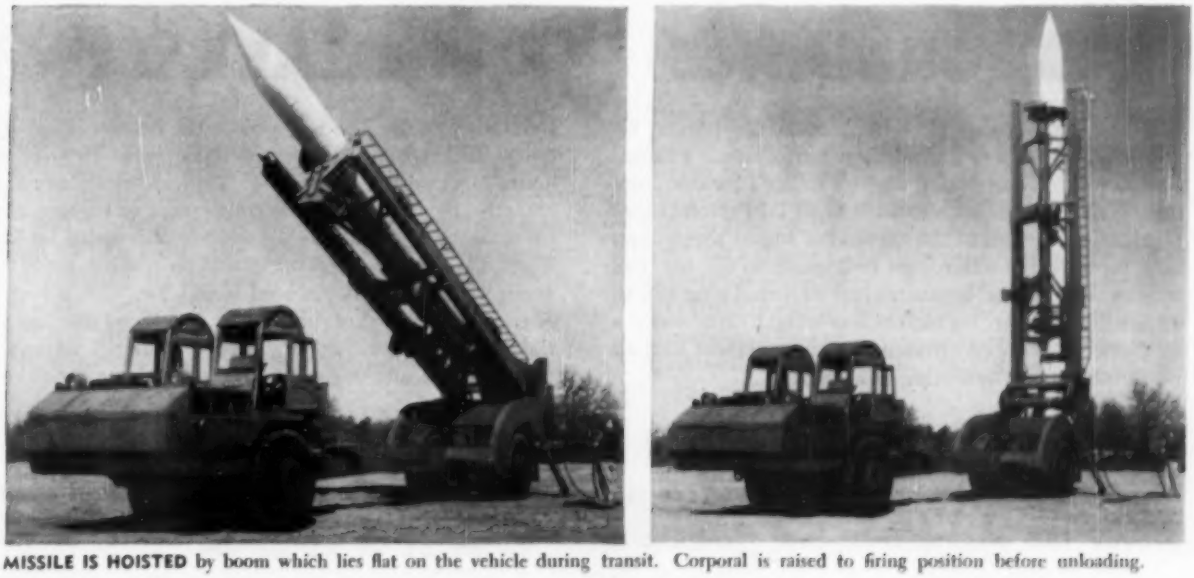
Here is how the Corporal Loader works:

The machine is positioned at the back, or hot, end of the missile. A boom, lying flat on the vehicle, swings rearward through 180 degrees and locks on to the missile. When the Corporal has been secured to the boom, it swings forward 180 degrees, hoisting the missile on the back of the vehicle.

The loader transports the missile over highway or rough battlefields to its launching site. Here missile is raised to its vertical firing position and placed on a launching platform. As soon as the Corporal is unloaded, the vehicle can return to the missile dump for additional Corporals while the first unit is fired.

A remote, hand-held control panel allows a single operator to actuate the missile-carrying boom as desired.

Vehicle is operated by one or two drivers who sit in twin sentry box-like enclosures with convertible tops.



MISSILE IS HOISTED by boom which lies flat on the vehicle during transit. Corporal is raised to firing position before unloading.

4000 HOURS OF TESTING SHOWS

PRO

PERFORMANCE

Military guarantees—1024 hp, 0.66 SFC—proved by unofficial Model Tests. And these performance guarantees have been bettered in engines shipped for customer use by as much as 90 hp and 0.02 SFC! Performance? Definitely. But not at the expense of engine weight and size, for with reduction gear and ready to fly, the T58 weighs only 325 lbs; measures just 59 inches long and 16 inches in diameter. Its high power-weight ratio and low SFC offer helicopters outstanding improvement in their performance and operating efficiency.

RELIABILITY

Reliability of the T58 is based on the extraordinary durability its components have demonstrated in over 4000 hours of development testing. Typical results are (1) no catastrophic failures, (2) no compressor or turbine bursts, (3) no trace of combustor deterioration in unofficial Model Tests, (4) no demonstrated effects on compressor life as a result of deliberately induced stalls! Yet, this is just part of the T58's record of ruggedness. In special weather tests, the T58 demonstrated its ability to start in sub-zero temperatures and operate under severe icing conditions.

Rugged development test program, conducted by the Navy's BuAer and General Electric, proves T58 engine is a real "workhorse"—capable of revolutionizing helicopter flight!

GENERAL ELECTRIC T58 ENGINE HAS

VEN

CONTROL STABILITY

To prove the stability of the T58's controls and their responsiveness to a helicopter rotor system, General Electric has subjected the T58 to over 150 hours of tests on this rotor stand. Despite throttle bursts and sudden collective pitch increases, the engine's control system kept power turbine speed loss to as little as 1%! At the same time, the gas generator and power turbine regained efficient operating speeds as fast as 4 seconds! Here, certainly, is proof that the T58 can provide extremely accurate rotor-speed command, more efficient helicopter operation.

POWER SPLITTING

The T58's excellent power-splitting ability makes twin-turbine-powered helicopter flight truly practical. Dual engine runs show the T58's control (1) automatically proportions output of both engines, at any collective pitch setting, (2) allows full military power to be drawn from both engines, (3) holds power differential between engines, at all collective pitch settings, to a minimum, (4) virtually eliminates manual rotor speed adjustment, (5) prevents excessive engine or rotor speeds. General Electric Company, Section 233-8 Schenectady 5, N. Y.

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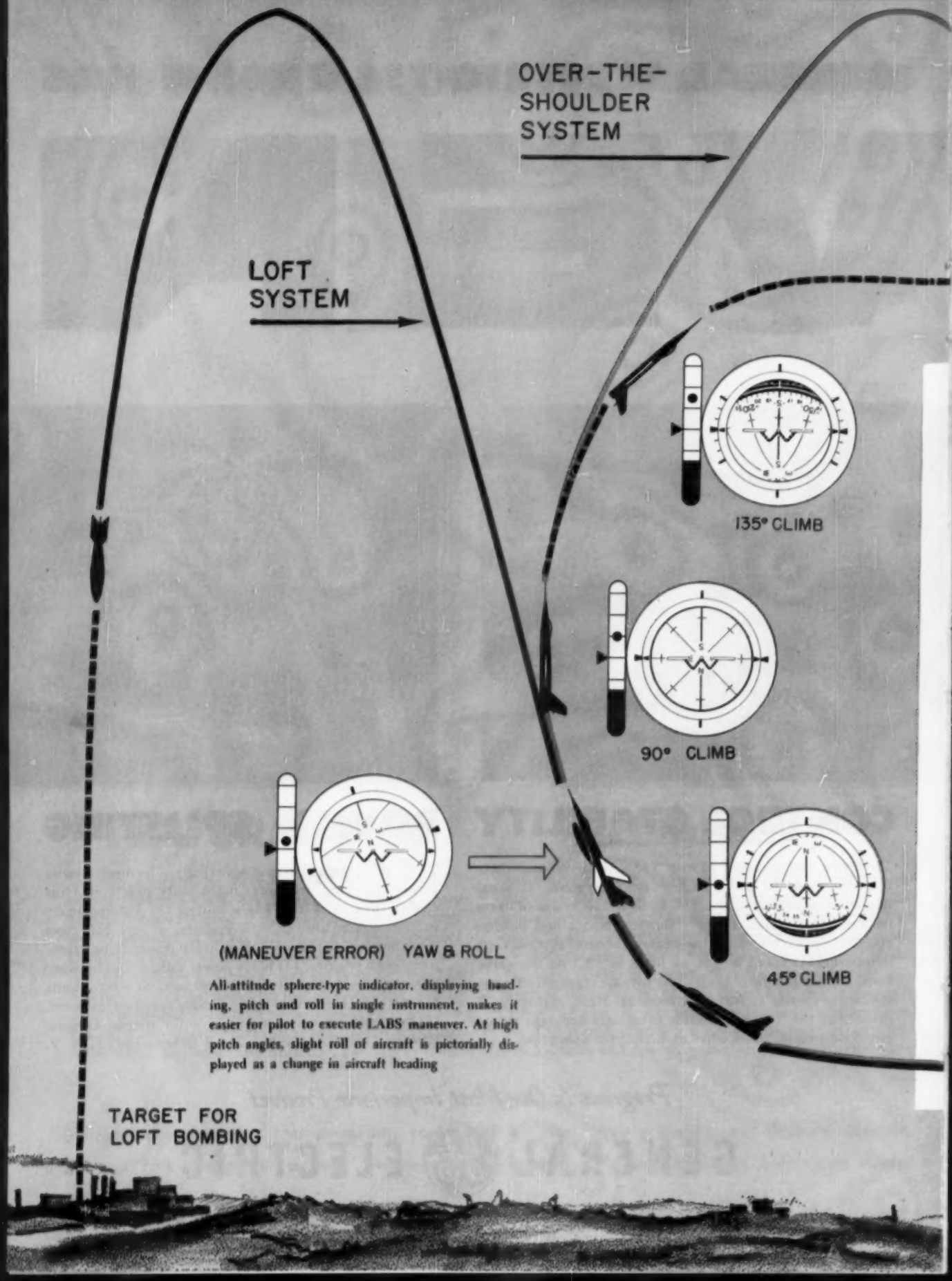
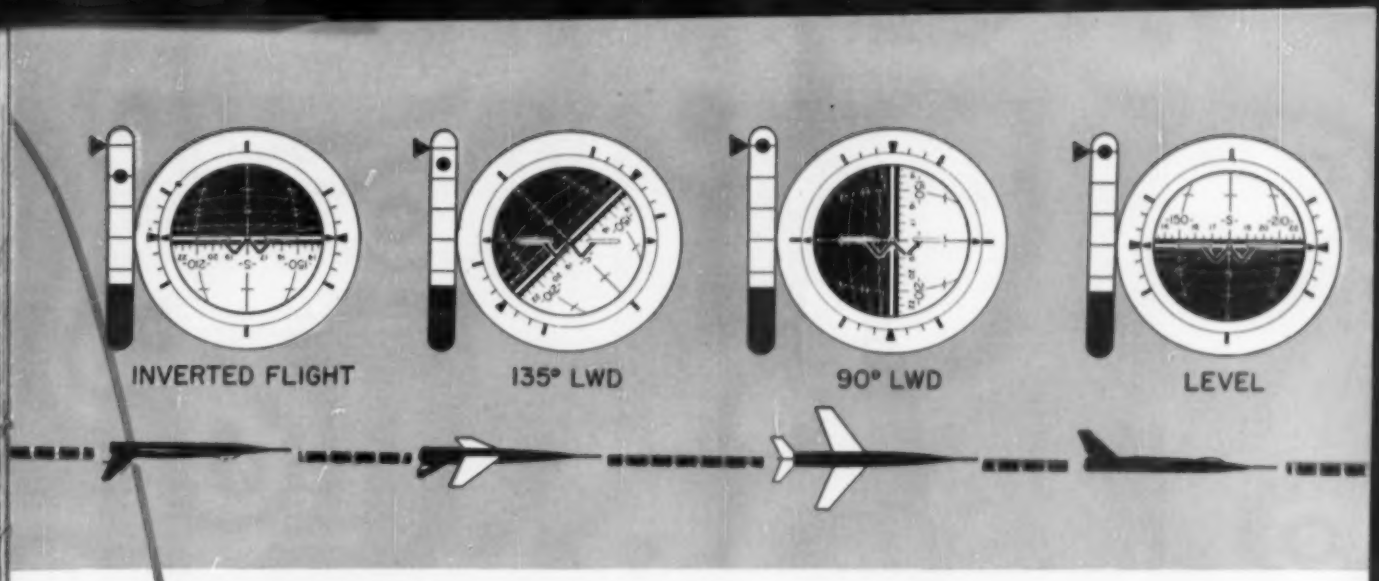


All-attitude sphere-type indicator, displaying heading, pitch and roll in single instrument, makes it easier for pilot to execute LABS maneuver. At high pitch angles, slight roll of aircraft is pictorially displayed as a change in aircraft heading



Bombing System Keyed to New Indicator

By Philip J. Klass

Grand Rapids, Mich.—First details have been released on Navy's new AJB-3 low-altitude bombing system (LABS) for both loft (toss) and over-the-shoulder bombing system.

The 60 lb. system, developed by Lear, features a novel all-attitude indicator that combines in a single instrument flight and bombing data previously displayed on three instruments; greatly easing the pilot's task. The new indicator displays:

- **Aircraft heading.**
- **Aircraft pitch and bank angles.**
- **Commands for executing the LABS maneuver.** A vertical accelerometer mounted along the instrument's left edge shows both desired and actual vertical G's.

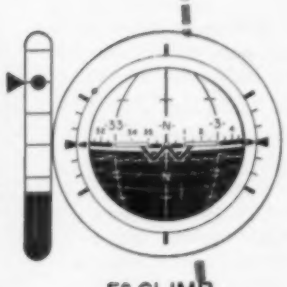
Both the Lear all-attitude indicator and the two gyro stabilized platforms, which supplies its intelligence, have unlimited freedom of movement about all three axes.

Lear is developing another version of its all-attitude indicator, with flight director provisions, which could find application in civil and other military aircraft. The device provides cross-pointer needles for displaying ILS, Vortac steering signals, plus a small arrow indicator (along left edge) to show aircraft position relative to glide slope. Under the main display sphere is a small ball-and-turn indicator.

Choice of loft versus over-the-shoulder bombing technique depends in part upon whether there is a suitable land mark, whose distance to the target is known, which will be reached before the target. Here's how both techniques work:

- **In loft bombing mode,** landmark serves as reference (called "initial point" or IP) for timing the start of bombing maneuver —an Immelmann turn. The bomb is released before aircraft pitch angle reaches 90 degrees, the specific angle depending upon target distance, aircraft speed and bomb characteristics. This gives bomb both a forward velocity (in direction of airplane's flight path) and a vertical velocity, which gives it a ballistic trajectory to the target. (See sketch.) The loft technique has the advantage of eliminating the need for the aircraft to fly over what may be a heavily defended target.
- **In over-the-shoulder mode,** the target itself serves as the IP reference for the start of the bombing maneuver, also an Immelmann turn. Bomb release occurs at a pitch angle exceeding 90 degrees so bomb is pitched back toward target and hoisted above airplane's turning radius.

The specific pitch angle at which the weapon is released is determined by bomb type, airplane speed and target. For loft-type bombing, the pilot refers next to precomputed tables to determine how long it will take his type aircraft, with mission load, to reach required pitch angle after he starts maneuver. From this figure, pilot can then work back to establish time in-



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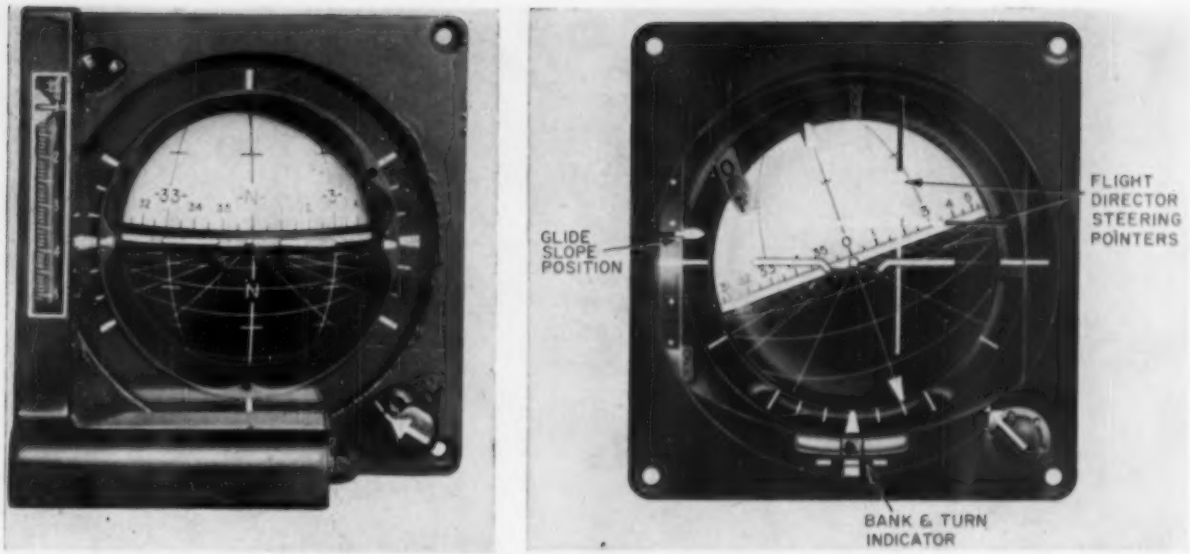


LABS three-axis indicator (left) displays heading, pitch, bank, desired and actual airplane Gs for LABS maneuver along left edge. Another version (right) will provide flight director steering needles, glide slope indication and bank and turn indicator.

terval after passing Initial Point when he must begin pull-ups.

Pilot sets bomb release angle into his LABS pitch selector, selects desired model of operation (loft or over-the-shoulder), then sets in the required time interval into the LABS intervalometer if loft-type mode is to be used.

When the airplane nears the target area, the sequence of operations for loft-bombing is as follows:

- **Pilot sets airplane** on heading to target.
- **When over IP point,** pilot pushes "pickle button" on control stick. This puts LABS in readiness and starts intervalometer.
- **After pre-set time interval,** intervalometer initiates maneuver command. This sounds audio tone in pilot's headset, flashes a warning light, and starts command index marker on the vertical accelerometer (mounted on left edge of all-attitude indicator) moving down. Marker index is driven by small timing motor.
- **Pilot pulls back on stick,** maneuvering in pitch so that vertical Gs indicated by small ball in vertical accelerometer matches position shown by command index marker. Pilot also maintains wings level to prevent any change in aircraft heading.
- **When pre-selected pitch angle** is reached, bomb is automatically released. The G-indicator light goes out to show "bomb's away."
- **Pilot completes Immelmann,** heads back to base.

'Favorably Impressed'

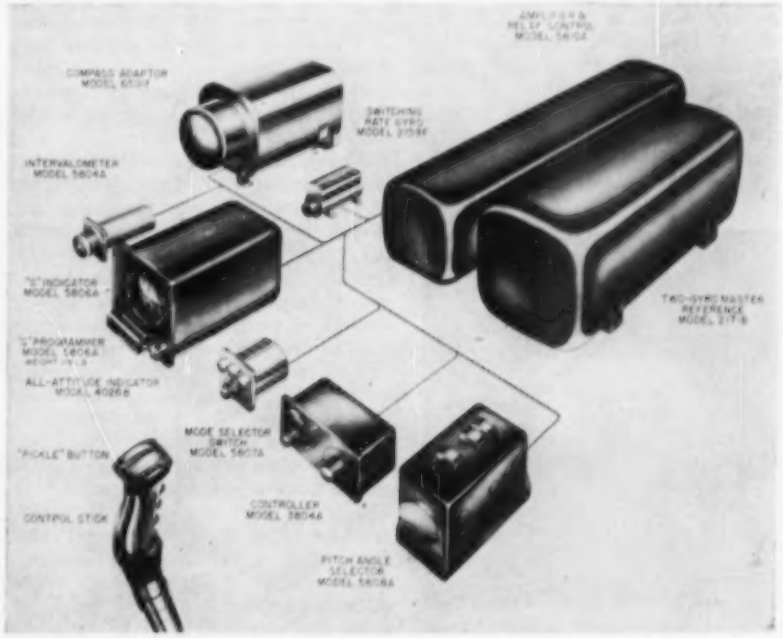
Lt. Hal Joins, Navy project engineer in charge of the AJB-3 system evaluation at the Naval Air Test Station, Patuxent River, Md., told AVIATION WEEK that pilots are "very favorably impressed" with this new Lear system, particularly the all-attitude indicator and its associated gyro-stabilized platform reference.

The concept of a three-in-one attitude indicator is not itself new. But the Lear design, inspired by suggestions made by Navy Test Squadron VX-5 at the Naval Ordnance Test Station, China Lake, Calif., for improving the LABS display, is believed to be the first to go into production.

Initial development was sponsored with Lear's own funds and an early version was favorably evaluated at NOTS, according to Ted Zwiep, AJB-3 project engineer at Lear. Navy BuAer subsequently sponsored the improved AJB-3. Air Force, which has ordered a LABS developed by Minneapolis-Honeywell, has obtained a Lear system for test purposes.

All-Attitude Indicator

Pilot enthusiasm for the all-attitude indicator leads Lear to believe that there is a market for this portion of the LABS system in aircraft not equipped



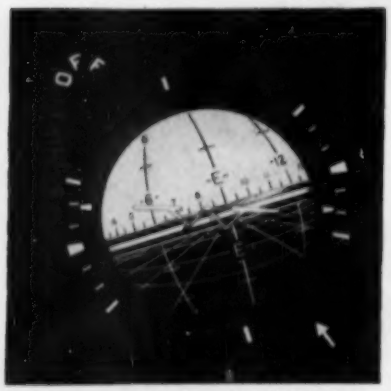
NAVY'S AJB-3 low-altitude bombing system components shown above total less than 60 lb.

LOW-ALTITUDE bombing maneuver, executed by B-47, begins with pitch-up (left). At preselected angle, bomb is released (right).

with low-altitude bombing systems.

The all-attitude indicator, associated stable platform and controls weigh less than 40 lb. (The remaining 20 lb. of the LABS system is used solely for the bombing function.) The stable platform can also provide heading, pitch and bank signals to a variety of other equipment aboard an airplane, such as autopilot, fire control, radar, navigation computers.

The indicator employs a four-inch diameter display sphere which incorporates two tiny servo systems within its shell to drive the sphere in pitch and azimuth. A flat disc which separates the two halves of the sphere is pivoted at two points to provide roll-axis freedom.



INTERNAL lighting provides full indicator illumination for night use.

With its three degrees of freedom, the sphere appears to be floating within the indicator case.

The display sphere is painted to give the illusion of VFR flight. The upper half is painted sky-blue; the lower half is dark with perspective lines to create the effect of spatial depth. (See accompanying photo.) Heading is marked off in five-degree increments along the horizontal, in 30-degree increments at high or low pitch angles.

Bank angle scale, around the indicator periphery, is graduated in 10-degree increments up to 30 degrees. A novel feature of the Lear design comes into play when airplane is flying at pitch angles above or below 70 degrees where changes in bank angle actually represent changes in airplane heading. When airplane pitch or dive angle exceeds approximately 70 degrees, bank angle graduations automatically disappear from the indicator bezel so that the pilot will think of aileron control in terms of its effect of changing airplane heading rather than in terms of bank angle.

The bank graduations automatically return when the airplane pitch or dive angle drops below approximately 70 degrees.

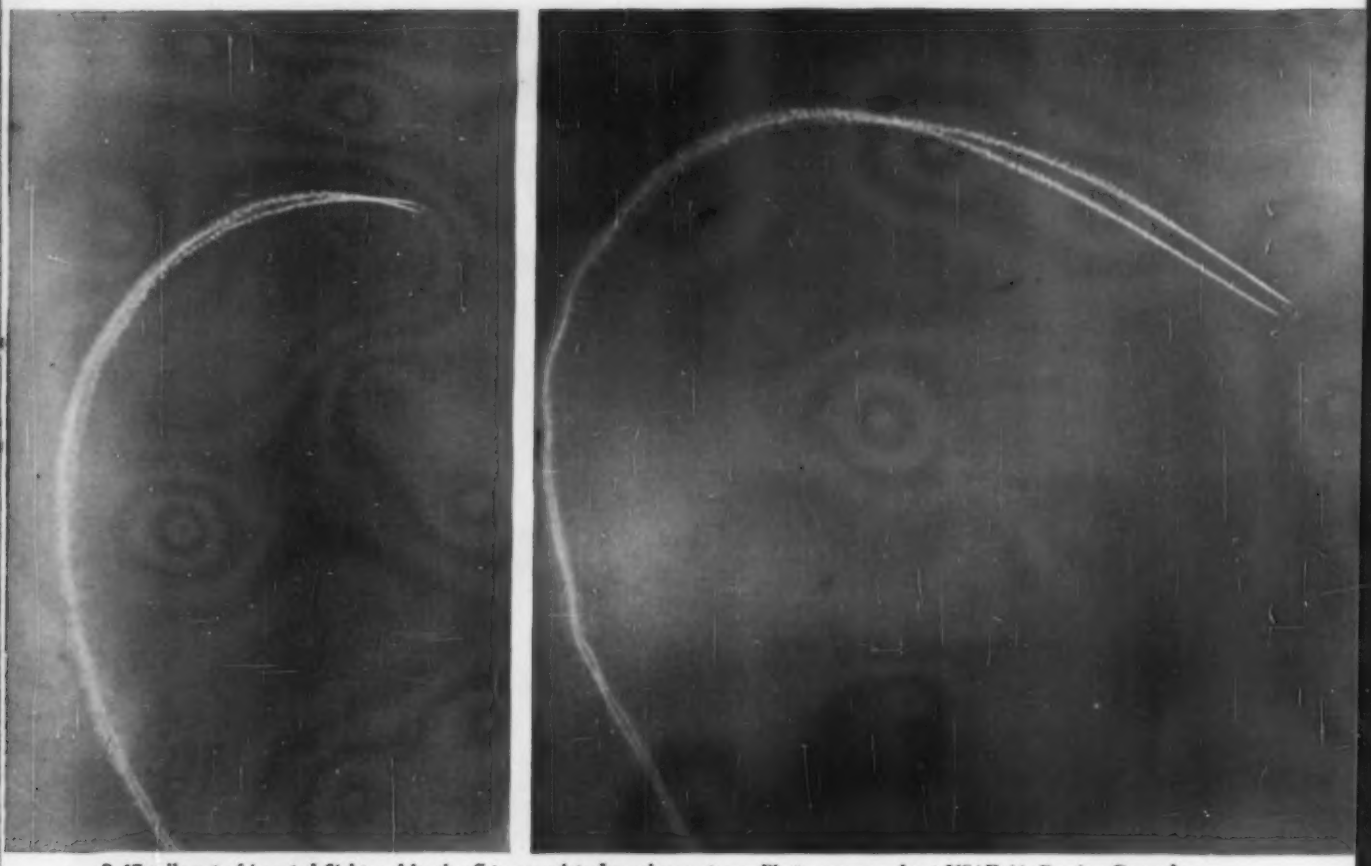
The 3-D display techniques are the result of human engineering studies by the Office of Naval Research and Army and Navy instrumentation programs.

The new all-attitude ball-type display required development of new integral lighting techniques for night operation. Lear has employed internal lighting which causes the entire translucent sphere and plastic bezel (with bank angle markings) to glow with standard instrument red lighting.

Gyro Stabilized Platform

Use of a stabilized platform in the AJB-3, instead of conventional gyro compass and horizon gyro, provides several important advantages according to Fred Herr, head of Lear's flight reference department:

- **Unlimited pitch, roll axis** maneuvering without gyro tumbling or discontinuity in pitch axis indication during an Immelmann turn.
- **Eliminates large heading** errors at



B-47 rolls out of inverted flight and levels off to complete Immelmann turn. Photos were made at USAF Air Proving Ground.

high pitch and bank angles, or during continuous turns.

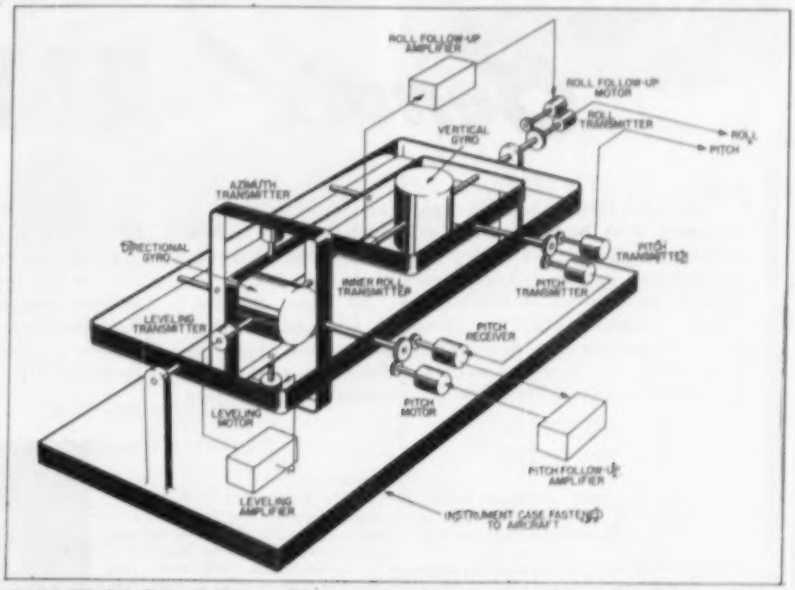
• **Can provide several different** heading, pitch, or bank signals for other aircraft equipment, because more than one synchro can be driven from the stabilized platforms powered gimbals.

Power Driven Gimbals

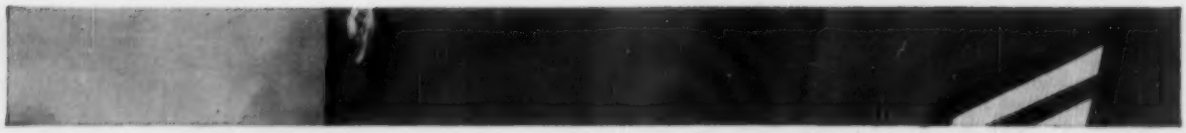
The two free gyros used are mounted on a common roll-axis gimbal, with separate pitch axis gimbals. These gimbals are power driven by small servo systems operating from signals generated by gyro pick-offs to maintain the gyro axes fixed in space despite maneuvers of the aircraft. (See accompanying sketch.) The servo amplifiers for the stabilized platform and the cockpit indicator are completely transistorized (silicon), except for a magnetic amplifier output stage used to drive the platform roll gimbal.

When airplane is operating at lower latitudes, the directional gyro is slaved to a remote compass element. At higher latitudes the directional gyro is operated unslaved, with automatic earth's rotation correction (providing pilot sets in approximate aircraft latitude). As a free gyro, drift rate is about two degrees per hour, but Lear already is working on modifications which it says will reduce drift rate further.

The vertical gyro is erected to the vertical by means of electrolytic leveling switches. During a turn, centrifugal forces would cause the erecting switches to shift gyro position to a false vertical. To prevent this, a rate switching gyro



GYRO-STABILIZED platform, which provides all-attitude intelligence for LABS indicator and other aircraft systems, permits unlimited maneuvering about all three axes.



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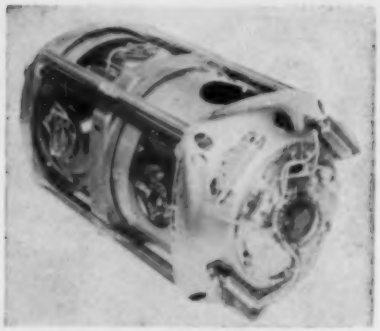


STABILIZED platform is small, compact.

automatically disconnects roll axis erection, and directional gyro compass slaving, whenever aircraft turning rate exceeds 15 degrees/minute. Fluid damping in the rate gyro prevents unintentional cut-off during turbulence.

Shockley Develops Bistable Transistor

Two-terminal transistor that functions as a bistable diode has been disclosed by the Shockley Semiconductor Laboratory of Beckman Instruments, Inc., Mountain View, Calif.

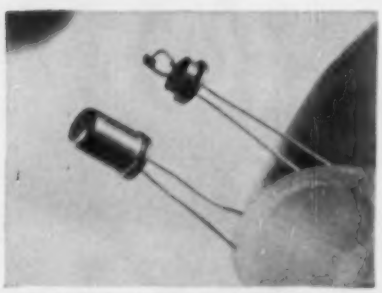
The two-terminal four-layer silicon device, originally developed by Shockley at the Bell Telephone Laboratories, exists in either of two states: an open or high impedance state (1 to 100 megohms) and a closed or low impedance state (1 to 10 ohms).

Characteristics of the four-layer diode suggest a range of circuit applications including self-excited sawtooth oscillators, pulse generators, bistable memory circuits, and ring circuits for counter and computer use.

The diode is switched from one state to the other through control of voltage and current values. It is driven to the closed state by application of a voltage greater than the critical breakdown value, and will continue conductive as long as a current greater than a critical holding value is maintained.

When the current is reduced below the holding value, the device regains its open state.

Operating parameters of the diode



BISTABLE diode performs as flip-flop.

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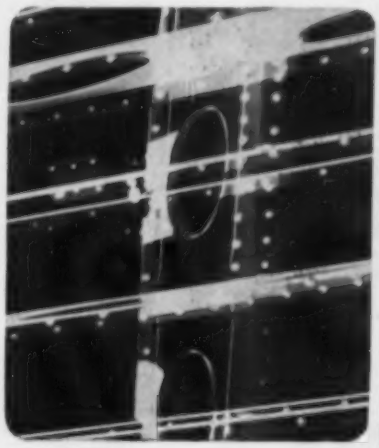

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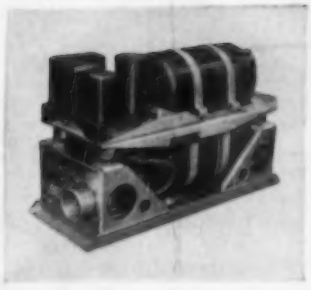

How Passive Refrigeration works in Honeywell components such as the autopilot sub-system shown here, is revolutionary in its simplicity. Around such sub-systems, Honeywell can put a jacket of special material which is solid at normal temperatures. At super heats, it becomes a semi-solid and soaks up the heat without changing temperature (heat of fusion). This keeps the operating temperature at a safe plateau in spite of transient super temperatures encountered at extreme speeds.

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Passive Refrigeration is another example of Honeywell Aero's continuing contributions to the research, development and production of airborne systems varying from guidance to fuel management, from engine control to flight stabilization.

If you are working on projects where super heats will be encountered, perhaps Honeywell Aero has the answer to your problems. Honeywell's Aero engineering group is prepared to develop components or systems utilizing Passive Refrigeration for any type of missile, rocket or aircraft. Contact Minneapolis-Honeywell, Aeronautical Division, 2600 Ridgway Road, Minneapolis 13, Minnesota.

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are controllable to some degree in manufacture. Typical ranges of values are as follows:

• **Firing voltage** ranges from 20 to 60 volts.

• **Holding currents** are 25 ma. or less at about one volt.

• **Switched-current capacity** is in the order of 100 ma.

• **Maximum power dissipation** is about 100 mw.

• **Present switching rates** reach 1 mc. although rates approaching 10 mc. are anticipated for the future.

Because the V-I characteristics are determined not only by the device but also by the constants of the external circuit, the complete current-voltage relationship, including certain 'negative resistance portions, must be considered.

A generic discussion of the four-layer diode is contained in an article by Moll, Tanenbaum, Goldey, and Holonyak appearing in the September, 1956, Proceedings of the I.R.E. (Vol. 44, p. 1174).

Expansions, Changes In Avionics Industry

International Telephone & Telegraph Co. has opened new standards laboratory, located in plant of its subsidiary, Federal Telephone & Radio Co., Clifton, N. J. IT&T calls its new facility "one of the best equipped privately owned installations of its kind in the world."

Other recently announced expansions and changes in the avionics industry include:

• **Sperry Rand Corp.** will make 100,000 sq. ft. addition to its Sperry Utah Engineering Laboratory, in Salt Lake, where company will produce new Army Sergeant missile.

• **General Electric's Missile and Ordnance Systems department,** Philadelphia, has opened new data processing and computation center which will be used in connection with its work on nose cones for the Atlas and Thor ballistic missiles. Facility includes analog computers with automatic switching provisions and an IBM 704 digital computer.

• **James J. Ward & Co.,** Stamford, Conn., is name of new organization set up to serve as sales consultants and manufacturer's representative in aircraft and missile fields. Ward, who heads new firm, formerly was vice president of Consolidated Diesel Electric Corp.

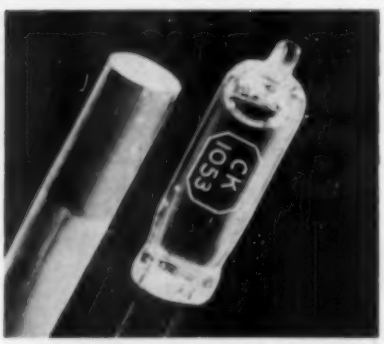
• **Consolidated Electrodynamics Corp.,** Pasadena, Calif., has changed name of its Electronic Industries division to the **Alectra division.**

• **Amphenol Electronics Corp.,** Chicago, has formed a new subsidiary, **Amphenol Great Britain Ltd.,** jointly owned with Gas Purification and Chemical Co. Ltd. of England. New subsidiary will make and sell Amphenol products in the United Kingdom and other Commonwealth nations, except for Canada where a Canadian subsidiary operates.

• **Bomac Laboratories, Inc.,** Beverly, Mass., is building million-dollar plant at its Route 128 site which will double company's present facilities. New plant will be used principally for magnetron production.

• **Aircraft Instruments Co.,** W. Conshohocken, Penna., is new name of the former Penn Keystone Co. George Peterson, Jr., remains owner.

• **Burroughs Corp.** has relocated and expanded two of its defense district offices. Dayton office, managed by William J. Cushing, is now located at 3898 Linden Ave., Suite 202. Los Angeles office, headed by Carl C. Jardine, is now at 17071 Ventura, Encino, Calif.



Electronic Hourglass

Operating time indicator for avionic equipment is subminiature tube whose color changes with length of time it has voltage applied to terminals. Two-element colorimeter is necessary to interpret tube color in terms of elapsed time. Type CK1053 time indicator can be operated up to 5,000 hours, is accurate to within 5%, consumes only a few microwatts. Manufacturer: Raytheon Mfg. Co., Newton 58, Mass.

FILTER CENTER

▶ **Signal Corps History**—"The Signal Corps: The Test" is name of new historical work describing activities from Pearl Harbor through the first 18 months of World War II. The 621 page volume may be purchased for $4.50 from Superintendent of Documents, Government Printing Office, Washington, D. C.

▶ **Automatic Language Translation**—New technique for computer programming which reportedly permits automatic language translation into idio-

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matic English has been developed by 32-year-old Hungarian technician at California Institute of Technology. Technique has been applied to four foreign languages, Russian, French, German and Spanish, using Datatron computer, produced by ElectroData division of Burroughs Corp.

▶ **New Radio Altimeter**—Emerson Research Laboratories has unveiled AN/APN-100, a compact 20-lb. radio altimeter which reportedly is accurate to within 2% from altitude of 3,000 ft. down to zero terrain clearance. The device employs an AM-FM modulated signal operating at X-band. Further information is available from Emerson's Government Electronics Div., 1140 East West Highway, Silver Spring, Md.

▶ **Army Buys Ryan Auto-navigators**—Ryan Aeronautical has received $1.5 million Army contract for its Model 120 doppler auto-navigator for use in L-20 liaison aircraft and H-19 helicopters, as well as in other Army aircraft.

▶ **Maj. Gen. Schriever to Speak**—Principal speaker at Wescon's all-industry luncheon, Aug. 23 in San Francisco, will be Maj. Gen. Bernard A. Schriever, commanding general of Air Force's Ballistic Missile Division, Air Research & Development Command.

▶ **Another Voice**—Voice data link system, which can automatically convert commands generated by air defense or traffic control computers into verbal messages, has been developed by Fairchild Controls Corp. electronics division. Computer command causes voice data link to select appropriate pre-recorded words from magnetic memory drum, piece them together into a continuous message which is then transmitted over conventional voice radio channels. For description of earlier voice data link, developed by Cook Electric, see AW, July 16, 1956, p. 89.

Vanguard Speedometer

Velocity of satellite launching vehicle will be measured by this integrating accelerometer, a pendulous gyroscope which senses acceleration, integrates it to give rocket speed. Device was developed by Reeves Instrument Corp.

Air Defense Plot

World's largest radar plotting board, installed at Air Defense Command, Colorado Springs, Colorado, plots movements of unidentified planes anywhere in the U. S., Canada or possessions. Main plotting surface is a single sheet of Plexiglas 30 ft. long by 19 ft. high and ¼ in. thick, with fluorescent edge lighting on all four sides. Board was designed and erected by Brooks & Perkins, Inc., Detroit.

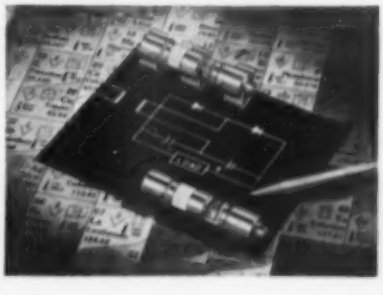
NEW AVIONIC PRODUCTS

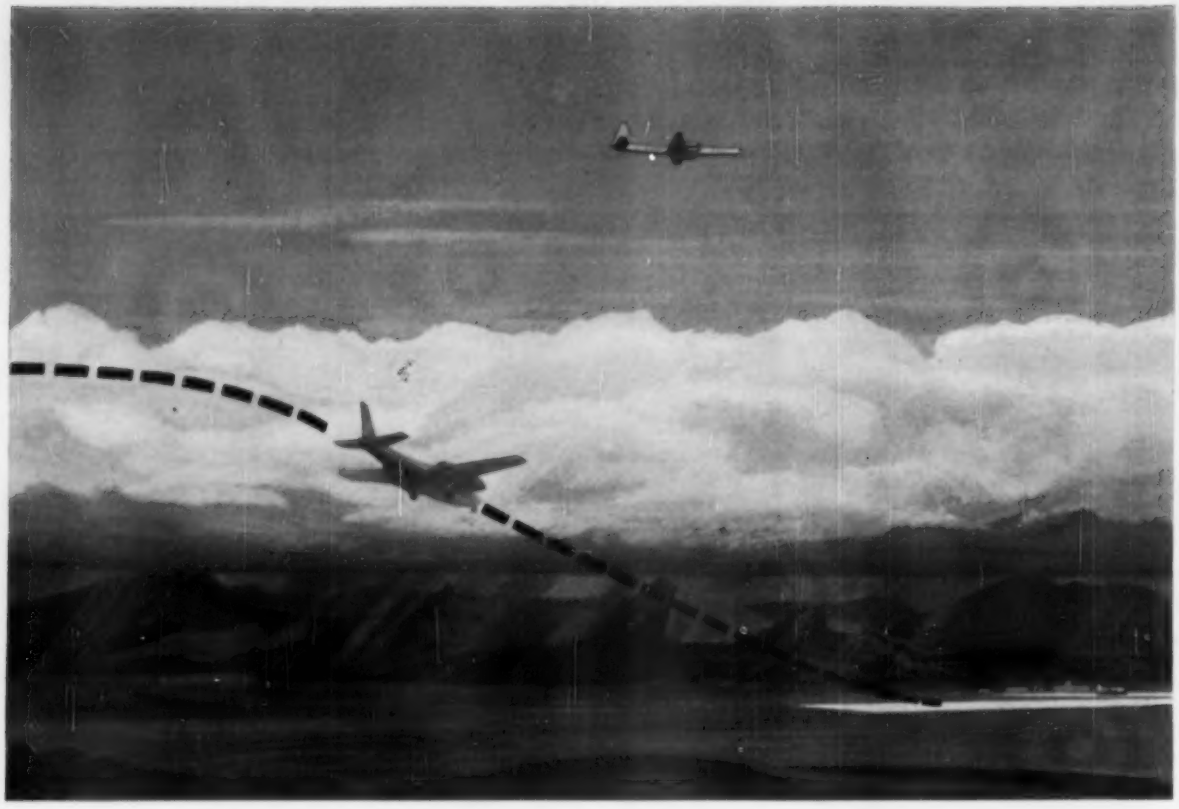
Components & Devices

• **Beam power pentode,** Type CK5902, has been added to the Raytheon line of Reliable Subminiature Tubes. A high perveance tube, it is for use as an audio power amplifier, series regulator or other applications requiring higher than average current and power dissipation. CK5902 has 6.3 volt, 450 ma. heater, 4.1 watt plate dissipation, 165 volt plate rating and maximum plate current of 30 ma., and is designed to meet requirements for military reliable subminiature tubes. Raytheon Manufacturing Co., 55 Chapel St., Newton 58, Mass.

• **Subminiature integrating gyro,** Type 101G, measuring 1 in. in diameter and weighing 3¼ oz., is designed for use in missiles and other airborne equipment where space and weight are at a premium. Three of them can be mounted in a sphere 3⅛ in. in diameter. Gyros are fully floated to keep friction and uncertainty torque to very low levels and give resistance to vibrational shock. Trimmed drift rates of 0.1 milliradians/sec. are quoted. Units are produced in varying impedances and sensitivities by the Reeves Instrument Corp., 215 E. 91st St., New York 28, N. Y., a subsidiary of Dynamics Corp. of America.

• **Silicon Cartridge Rectifiers,** applicable to airborne military equipment operating in ambient temperatures from −55°C. to 150°C., are voltage doublers with maximum rating per leg of 3,200 PIV. Two cartridges connected as a single-phase, full-wave bridge are capable of delivering 1,900 volts d.c. at 90 ma. for an input voltage of 2,240 volts rms. at 75°C. Measuring 37/64 in. in





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New Bendix 20-Channel Glide Slope Receiver for Airline and Business Aircraft Features Big Performance in a Little Package

Here's the latest addition to the Bendix* line of ILS Approach Equipment. We call it the GSA-8A Glide Slope Receiver. You'll call it just about the most dependable instrument of its kind. And here's why:

The GSA-8A is all new from circuitry to case. Not just a modification or repackaging of old designs. The result is a tremendously higher degree of course stability, and more accurate, reliable flag alarm information. Weight has been reduced considerably. The receiver weighs 7¼ lbs. with AC power supply . . . 7 lbs. with *transistorized* DC power supply.

The complete unit, including either power supply, is housed in a short ¼ ATR case. The chassis is mounted vertically. Tubes and adjustments are on one side, circuit components and wiring on the other. When the case is removed both *wiring* and *tubes* are visible, and access to each is easy for routine maintenance.

For further information write Bendix Radio Division, Aviation Electronic Products, Baltimore 4, Maryland. Or on the West Coast—10500 Magnolia Blvd., N. Hollywood, Calif.; Export—Bendix International Division, 205 E. 42nd Street, New York 17, N.Y.; Canada — Computing Devices of Canada Limited, P.O. Box 508, Ottawa, Ont.

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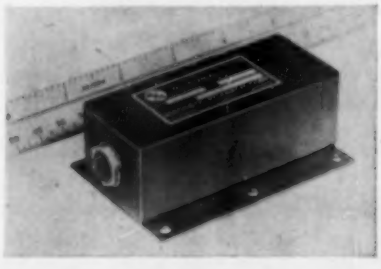
GSA-8A Glide Slope Receiver

Bendix Radio Division

Bendix AVIATION CORPORATION

diameter, rectifiers are available in two lengths, 2½ in. and 4⅛ in. Cartridge design permits mounting in standard 30 amp. fuze clips. International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.

• **Magnetic amplifier,** the Micromag MMO-528, is a low-level d.c. signal amplifier capable of operating from a 28 volt aircraft or missile system. Unit features a built-in transistor oscillator which generates its own frequency, enabling operations from a d.c. source. Built-in voltage regulator eliminates

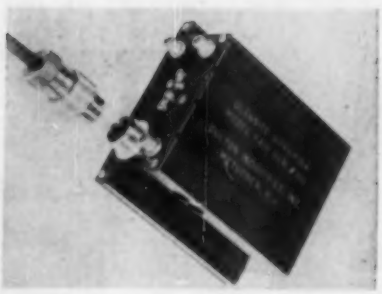


need for a separate supply. With a voltage gain of 500, MMO-528 achieves 5 volt output from 10 millivolt input signal. Compensated temperature range is 0° to 60°C. and can be extended to 85°C. Unit is designed to meet MIL-E-5272A specifications. Magnetic Research Corp., 3160 W. El Segundo Blvd., Hawthorne, Cal.

• **Matched transistor pairs,** both PNP and NPN types, are available from General Transistor Corp., as its SMP Series. The pairs are matched in five contiguous beta categories for applications such as transformerless Class B push-pull output stages, DC coupled amplifiers and balanced modulators. Data sheet is available from General Transistor Corp., 91-27 138th Place, Jamaica 35, N. Y.

• **Heat exchangers,** Models CR-2, CR-5 and CR-7, will dissipate 2,000, 5,000 or 7,000 watts and are adaptable to any intermediate rating. Models meet environmental conditions of MIL-E-5272 and MIL-E-5400 specifications and, according to manufacturer, are 20% less costly, 30% lighter and more compact than comparable existing units. Special features include a choice of cooling fluids, silicon oil, ethylene-glycol solution or hydraulic fluid for flexibility of application, and operation with maximum efficiency up to 70,000 ft. at 71°C. Hallicrafters Co., 4401 W. Fifth Ave., Chicago 24, Ill.

• **Miniature transducer amplifier,** Model F-418, uses ruggedized subminiature tubes individually selected for low microphonics. Filaments are ungrounded to assist in minimizing noise. Units are available with fixed gains

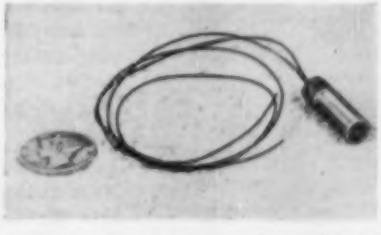


from 10 to 100 and variable gains from 10.2 to 99.5. For special applications, where extreme environmental conditions warrant, the amplifier can be potted. Gulton Industries, Inc., 212 Durham Ave., Metuchen, N. J.

Instrumentation

• **Accelerometer** for high response systems provides large linear a.c. output signal while maintaining high natural frequency and low cross talk. Device meets MIL-E-5272A with the following variations: temperature range from

−40°F. to 185°F., shock to 60 G, vibration of 30 G from 10 to 2,000 cps. Temperature-compensated fluid maintains constant damping over the operating temperature range without a heater. Pacific Scientific Co., P. O. Box 22019, Los Angeles, Calif.



• **Miniature magnetic pick-up,** Model 3055, creates external magnetic field which, when interrupted or distorted by movement of external ferrous metal object, generates an a.c. output voltage. Pick-up measures ¼ in. dia. x ⅞ in. long, operates at temperatures up to 250F. Electro Products Laboratories, Inc., 4501 N. Ravenswood Ave., Chicago 40, Ill.

• **Recording oscillograph,** Type 5-122, developed for flight test recording at high temperatures, operates from −65°F. to 250°F. at altitudes up to 120,000 ft. The 5-122 records up to 26 channels at writing speeds in excess of 12,000 ips. Twelve record speeds give a range of 0.047 to 96 ips. with a "jump speed" system permitting preselected jump speed ratios of 8:1, 4:1 or 2:1.

Instrument weighs 80 lb. and measures 11x8x18¼ in. Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Cal.

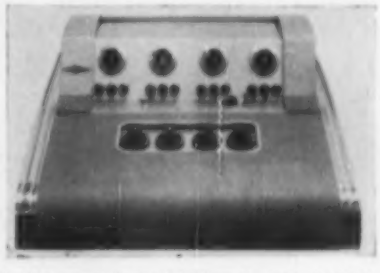
Computers and Data Processing

• **Function Programmer** provides switching as well as potentiometer control of electrical and electronic circuitry in relation to time. Up to 16 separate functions can be accommodated with eight detachable function switch strips.

Pulsing switch is provided for deriving pulses in one-half second increments or any multiple of one-half second. Motor requires 350 ma. Time of travel is 50 sec. ±0.1 sec. Information available from Hubbard Scientific Laboratories, Inc., 1292 E. Third St., Pomona, Cal.

• **Digital-to-analog converter** has standard output resolution of 0.05% of full scale with 10-turn potentiometer. Higher resolution is available on special order.

Output accuracy is dependent on reference voltage source and can be



held to ±0.1% of full scale with 0.05% linearity potentiometers. It is about the size of an electric typewriter. Converter may be used with most X-Y plotters. Litton Industries, Electronic Equipments Division, 336 N. Foothill Rd., Beverly Hills, Cal.

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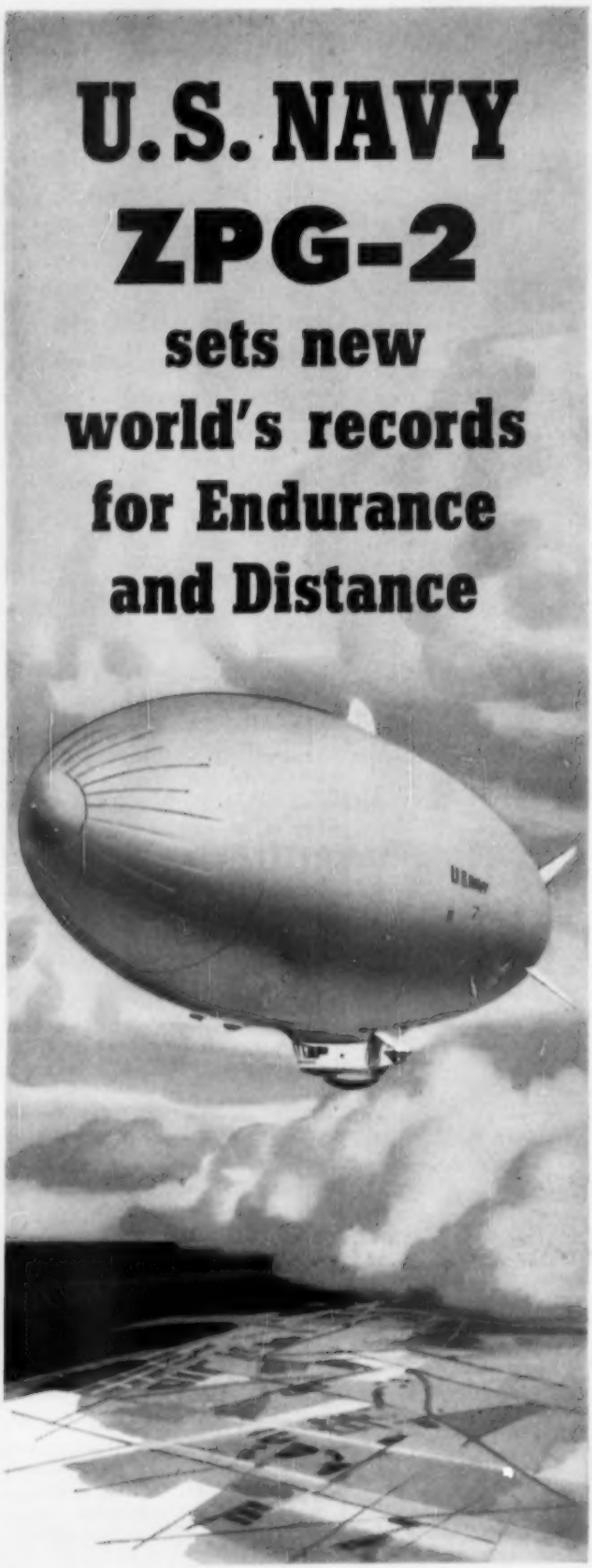

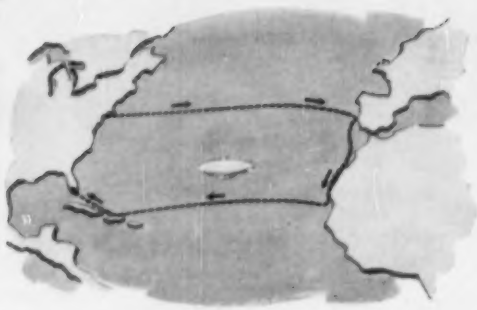

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A U. S. Navy ZPG-2 non-rigid airship made news recently in an 11-day nonstop, non-refueled flight from South Weymouth, Mass., across the Atlantic, along the coasts of Portugal and Africa, and back westward via the West Indies to Key West.

The flight, to evaluate prolonged operations of airships in anti-submarine and airborne early warning radar service, lasted for 264 hours and 12 minutes, and covered 9,448 statute miles – setting new world's records for both time and distance, under tough flying conditions that included snow, rain and high winds.

The record-breaking ZPG-2, like all other U.S. Navy airships of its class, is powered by dependable Curtiss-Wright Cyclone 7s – teamed with Curtiss-Wright Electric Propellers.

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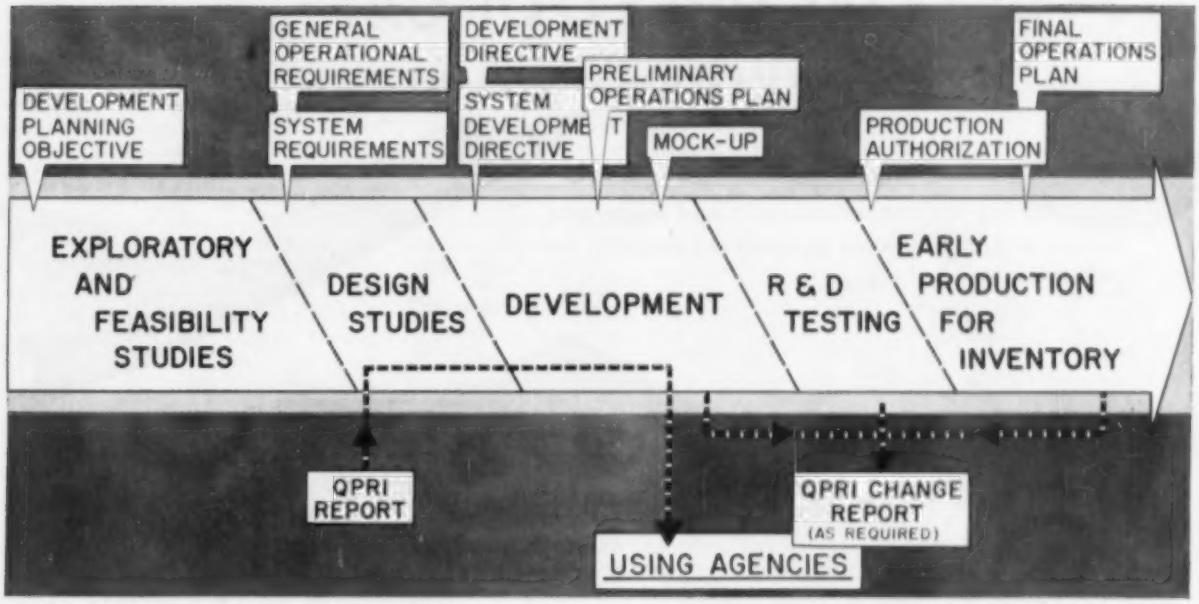

WHERE QPRI fits into the weapon systems development chain is indicated on this chart. Industry has found the system effective.

Report on QPRI: Part I

USAF Program Welds Men, Hardware

G. L. Christian

Lackland AFB, Texas—New concept, Qualitative Personnel Requirements Information (QPRI)—sometimes called "the solder which binds together the Air Force's weapon systems and its personnel systems"—has been developed by USAF to pierce the human barrier.

QPRI (AW Aug. 6, p. 353) ties together the training, the hardware, and the personnel aspects of weapon system development so that when the equipment is delivered to the operational unit, it can be put to immediate operational use.

QPRI accomplishes this by identifying and clarifying, as early as possible, the potential personnel and training problem areas that might tend to limit the effectiveness of a weapon system.

"QPRI is considered a necessary adjunct to the success of weapon systems, even if applied in limited form . . . it has become so essential that it will be included on all major future Air Force weapon systems," USAF officials here told AVIATION WEEK.

Weapon system airframe manufacturers endorse QPRI. One says, "The use of QPRI should be expanded. In fact, the rapid advancements being made in the aviation industry today virtually dictate that using personnel requirements be considered in design to obtain full utilization of a weapon system at the earliest possible date. . . . QPRI reduces the time lag in achieving a weapon system's operational status to a minimum. QPRI helps to produce more national security with less expenditure of money, manpower and other valuable resources."

Another aircraft builder echoes this view, "We can expect long term benefits from QPRI because it will result in the optimum use of this country's biggest asset—trained personnel."

To date, QPRI has been considered for about 80 weapon systems and has been activated to a greater or lesser extent on about 50.

The Office for Qualitative Personnel Requirements Information lies within the framework of USAF's Air Force Personnel and Training Research Center. AFPTRC itself is a relatively new member of the Air Research and Development Command, having been created early in 1954 by integration within ARDC of three previously separate human resources research agencies.

A QPRI program is the personnel sub-system within the development program of a weapon system. It thus becomes one of the many sources which furnish the systems management office with inputs that are part of the master integrated program for weapon system development.

Importance of QPRI is underlined by this more formal definition of its dual goal: "To quickly identify and define new tasks within the Air Force which are generated by new weapon systems and to insure that the right men will be at the right place at the right time so that the weapon system will be fully operational when delivered."

Another important QPRI function is the determination of new training device characteristics.

Why a QPRI program? In the past, when new equipment was developed, human factors were largely overlooked during its early development. Often this resulted in deficiencies in equipment, maintenance, operation and support, and weaknesses in design, training plans, personnel plans and the phasing of equipment into operation.

With the advent of QPRI, the human factor is considered throughout weapon system development. Result sought is greater effectiveness of each new weapon system because:

- **New positions** are identified early in the development cycle.
- **Personnel and training** needs are considered well in advance.
- **Training parallels** hardware development.
- **Adequately trained** personnel are available when and where needed.

Office of QPRI handles about 50

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Convair F-102-A

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Illustrated above are typical structural machined aircraft parts and assemblies currently being manufactured in the two divisions. The aircraft divisions operate under Air Force approved Quality Control systems. Each division possesses the most up-to-date equipment for its specialty including many pieces of equipment designed around a particular part. . . . . .

Convair B-58

Boeing B-52

H&B AMERICAN MACHINE CO., INC.

General Offices: Prudential Plaza, Chicago 1, Illinois

projects of widely different goals within these three separate branches:

• **Strategic Systems Branch**—Has QPRI responsibility for strategic missiles such as the SM-62 Snark, SM-64 Navaho and SM-73 Goose; guided aircraft missiles such as the GAM-63 Rascal, GAM-67 Crossbow and GAM-72 Quail; and bombardment aircraft such as the 102A/L B-58 Hustler, 110A/L CPB (chemical powered bomber) and 125A/NPB (nuclear powered bomber). In addition, this branch produces QPRI on systems managed by ARDC's Ballistic Missile Division and the Atomic Energy Commission. For BMD, the office produces QPRI for the SM-65 Atlas intercontinental ballistic missile, the SM-68 Titan ICBM, the Thor IRBM and 117L advanced reconnaissance system. For the AEC, the office has projects on APPR (Army Package Power Reactor) and ALPR (Argonne Low Power Reactor).

• **Tactical and Defense Systems Branch**—QPRI is assigned in support of fighters, missiles and a bomber. Fighters include: MRI (Medium Range Interceptor), F-101B, F-104A, F- and RF-105B and F-106A. Missiles include: IM-70 Talos, IM-99 Bomarc, TM-61B Matador, GAR Falcon, and Sidewinder. The bomber was the canceled XB/RB-68 Martin tactical aircraft.

QPRI is also produced for systems developed by Air Force Cambridge Research Center. These are: BADGE (Base Air Defense Ground Environment), a small version of SAGE, and CAC&WS (Continental Aircraft Control & Warning System), and for a ground environment system developed by Rome Air Development Center, the BMDSS (Ballistic Missile Defense Support System).

• **Support Systems Branch**—QPRI projects support the development of these support systems: Cargo and training aircraft such as C-130, C-132, KC-135, T-37, and weapon system project 445L, labelled Jet Cargo; drones, including the Q-2, -4, -5, and -9; rotary wing XH-40 utility helicopter; electronic systems: weapon systems 432L Crash Locator and 438L Intelligence Data Handling; air traffic control: weapon system 431L Traffic Control Approach & Landing.

This partial listing of Air Force projects incorporating QPRI shows a large variety of applications. The list gives import to this statement by an AFPTRC official, "QPRI can be on anything—a bolt and nut, on a major component, or on a huge weapon system. . . . The concept is the 21st Century's job analysis program."

He added that he hoped his prediction would come true despite a 1958 AFPTRC budget cut of 25%. This will drop manpower from a current 750 to about 610 persons and slice funds from $6 million to $5 million.

AFPTRC's personnel roster is composed of 416 civilians of whom 174 are scientists with 100 holding doctor's degrees; 136 officers of whom 82 are research and development specialists and 14 hold doctor's degrees, and 201 airmen of whom 24 have college degrees.

Center's headquarters and personnel laboratory are here at Lackland AFB. It has a maintenance laboratory at Lowry AFB, Colo., and an operator laboratory and an office for social science programs, both at Randolph AFB, Texas.

Personnel Answers

Here are some of the questions QPRI answers to improve the effectiveness and efficiency of Air Force personnel operations:

• **Will USAF be able** to match available manpower resources to the operation and maintenance requirements of its increasingly complex weapon systems?

• **What new skills** will be required by a new weapon system?

• **What skills can** be salvaged from previous systems?

• **What major training** devices will be necessary?

Data to answer these questions and form QPRI reports come from three sources: studies by industry, weapon

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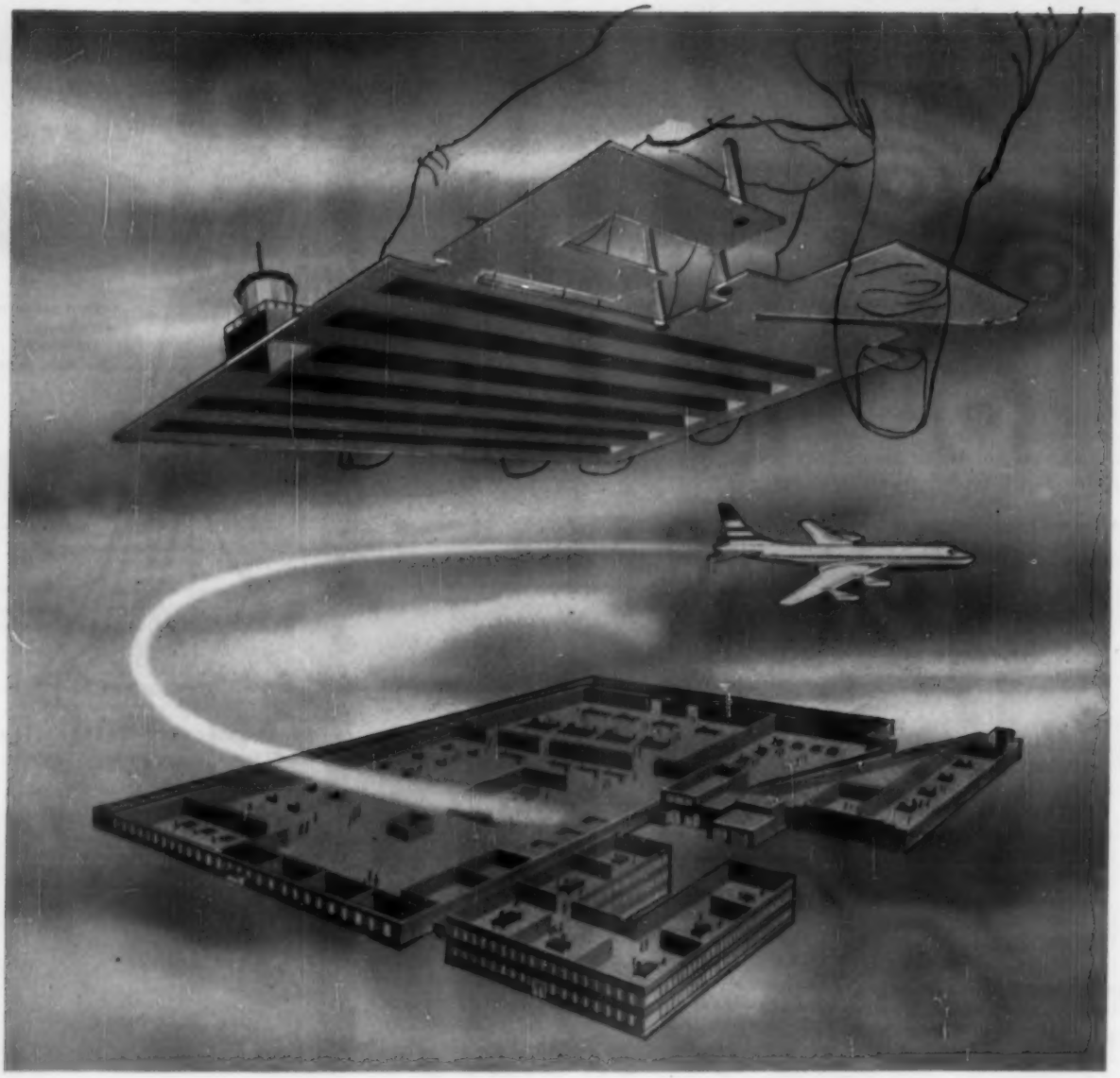

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JACK & HEINTZ AIRCRAFT SYSTEMS AND EQUIPMENT

system documents and ARDC technical programs.

Convair Fort Worth, builder of the supersonic B-58 Hustler bomber, says: "Application of QPRI has a favorable impact on Convair's weapon system development. In essence, information required to establish qualitative personnel requirements is compiled by the operations analysis and service sections of our engineering department concurrently with weapon system's design.

More Compatible

"Incorporation of this data in preliminary stages of the design task enables us to develop a more compatible man-machine system. Publication of a QPRI report gives us the opportunity to present this information in a single document.

"Among the advantages we at Convair attach to the QPRI program are: earlier use of a weapon system; more effective operation and maintenance and therefore more salability; it is an aid to operation and ground support during customer test phases of weapon system development; QPRI reports form the basic customer and manufacturer source of material for manuals, handbooks, etc.; it assures that customer concepts and training programs are in phase with a weapon system's development and helps a manufacturer to become more familiar with customer maintenance and operating problems; it presents an avenue for the manufacturer to express his personal ideas to his customer."

Boeing Airplane Company summarizes its opinion this way: "The airplane manufacturer is required to sectionalize maintenance planning for any new weapon system. To accomplish this planning realistically, the manufacturer must either prepare or have access to QPRI.

"We feel that QPRI should be expanded to start early in the weapon system concept and should continue to be used as long as the system is in use."

Support Personnel

Because so many functions are being taken over by electronic and other automatic equipment, the number of operator personnel is declining in about the same proportion as the need for support personnel is rising. Conversely, the growing need for support personnel results from having to maintain the weapon systems and their complicated sub-systems such as avionic bomb navigation systems, jet engine fuel controls or hydraulically-powered flight controls.

Each weapon system generates specialized manpower requirements of its own. Here are some examples:

• **F-86D.** Introduction a few years ago of an electronically-operated fuel control on the plane's GE-J47-GE-17 jet took

ROCKET POWER PROGRESS REPORT

Achieving Rocket Reliability

by Bernard Tiger

Currently investigating new concepts in the design and demonstration of rocket engine reliability, Mr. Tiger is a senior engineer in the Systems Department, Component Development Division at Reaction Motors, Inc. Prior to joining the company in 1956, he taught communications electronics and was a consulting electronics engineer. Mr. Tiger received his B.S. in Mathematics and Statistics from Brooklyn College and is now engaged in postgraduate work in Applied Statistics at Stevens Institute.

Before a rocket is fired, there must be a high probability (i.e. reliability) that the rocket will successfully accomplish its mission. The expense and potential destruction is too great to needlessly risk unsuccessful firings.

As a result, the science of Reliability Engineering has been applied. It specifically deals with:

(1) the design and development of reliable rocket systems, and

(2) the determination of test procedures to demonstrate this reliability.

This article will briefly describe some of the factors that RMI has found important in the design and development of reliable rocket power systems. They include:

(1) *Component Homogeneity:* Production components must be as identical as possible with each other and with those that undergo reliability testing. Design and development engineers should keep in mind the necessity of developing prototypes that can be mass produced with a minimum of variability.

(2) *Simplicity:* Design and construction should be such that the number of parts necessary for successful operation is minimized.

(3) *Use of Proven Parts:* Fully developed and time tested parts should be used wherever possible.

(4) *Determination of Environmental Stresses:* Maximum "stress" levels (temperatures, altitude, vibration, etc.) to which the rocket may be subjected must be carefully determined. If any specified "stress" level is estimated too low, the rocket may be doomed to failure.

(5) *Elimination of All Possible Causes of Failure:* All possible causes of failure that may be encountered during the rocket's life cycle should be recognized and eliminated. Design solutions should apply to the mass produced part as well as to the prototype.

(6) *Reduction of Severe Operating Requirements:* The effect of severe operating requirements should be minimized wherever possible. For example, if a part cannot be built ruggedly enough to withstand the effects of vibration, the part may be shock-mounted.

(7) *Statistical Quality Control and Acceptance Testing During Production:* Statistical quality control should be maintained on all types of components. Acceptance sampling should be performed regularly. Statistical quality control should include "test-to-failure".

(8) *Redundancy:* The use of two parts that are capable of performing the same given function is often desirable in order that, should one fail, the other can do the job. However, the necessity for redundancy should be carefully weighed against resultant penalties (increased weight, for example). If redundancy is to be applied, it should be carefully checked by both the engineer and statistician. The engineer should determine the feasibility of the proposed redundancy, and the statistician should determine if the redundancy will effectively increase reliability.

(9) *Fully Trained Personnel Who Are Aware of Responsibility:* Everyone involved with rockets and rocket components must be fully trained and aware of the possibly disastrous effect of even one defective component. Each person should prove his competence before he is permitted to work on any parts that are to be used in the field.

As indicated above, applied mathematics and statistics are vitally important in the fields of rocket development and production, especially when reliability is a factor. Qualified men with this background, as well as other forms of science and engineering, have an almost unlimited opportunity to grow and develop at RMI. If you are interested in such opportunities and feel you have the necessary qualifications, there's an excellent possibility that you can become a member of the RMI team. Why not find out today?

This article is one of a series written by RMI engineers and scientists on different technical aspects of rocket engine design, development and production. Titles of the other articles are:

Tailoring Molecules for Rockets (propellant considerations) 5283

Taming Rocket Powerplants (engine control)

Atomic Radiation for Rocket Testing (test and instrumentation)

Servicing Rocket Engines—two parts (field service)

If you desire one or more reprints of any of these articles, or would like to receive further information about employment at RMI, write to our Information Services Coordinator, Reaction Motors, Inc., 14 Ford Road, Denville, New Jersey.

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B. A. ERICKSON, Chief Test Pilot at Convair-Fort Worth, first to fly these famous Convair aircraft – B-32, B-36, YB-60, YC-131C, and now the revolutionary, supersonic Convair B-58 jet bomber.

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"As Chief Test Pilot at Convair-Fort Worth, I've flown initial and subsequent tests on several of the outstanding aircraft created by Convair's design and engineering teams. Surpassing all, however, is their newest and most significant achievement, the Convair B-58 . . . built for the U. S. Air Force.

"The Convair B-58 is a completely integrated aerial weapon system. As America's first supersonic bomber, the B-58 has the capacity for sustained supersonic flight which represents a performance break-through vital to American military aviation. Such an accomplishment reflects the ability of Convair engineers and scientists to think far beyond conventional ideas of design and performance."

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USAF's engine mechanics by surprise since few of them had any knowledge of electronic systems. This was a case of research and development outstripping available labor skills, and considerable confusion resulted until engine mechanics were trained on electronically operated fuel controls.

• **F-104:** Simulators are not employed to train its pilots. A part task trainer, taking advantage of pilot versatility, acquired through years of flying, can do the training job. However, intensive lock-on training is needed to teach F-104 pilots how to get on and stay on target.

• **B-58.** Because of the degree of automatic control incorporated in this plane, the commander's main duties shift from the diversified task of piloting the aircraft to the monotonous job of monitoring a lot of dials, indicators and lights.

Two problems are created by this shiftover: First a new personality parameter is created. The pilot must be capable of switching instantly from the routine monitor tasks on recognition of an emergency to manual control of the aircraft even under critical and unstable flight conditions. Although not new, the range of this personality requirement is much greater than in the past.

Second, one malfunction may engender other troubles. How can a pilot solve a problem if he does not know how many malfunctions may be hidden behind the one or two that appear to him on his instrument panel or trouble lights? And how is a pilot trained to recognize and correct troubles when their multiplication and course are unpredictable? A simulator is required to train the pilot to cope with emergencies.

• **WS125A:** Most operational training for this nuclear-powered bomber will have to be performed on the ground to avoid exposing the crew to reactor radiation as much as possible.

Intelligence & Inference

Some of the knottiest problems which AFPTRC scientists have to unravel lie in such nebulous areas as determining whether or not a specific pilot, for instance, is qualified to fly a specific airplane.

Center scientists are concerned with analyzing mental ability. They divide it into four mental factors which blend into each other.

• **Mechanical aptitude,** or the ability to perform manual, mechanical tasks with more or less dexterity;

• **Academic, or clerical, aptitude.**

• **Psychomotor reaction,** which pertains to muscular action ensuing directly from a mental process;

• **Reasoning,** which is a problem-solving ability—an originality or creativity dimension.

In order to prepare a valid QPRI on any given weapon system, technicians must be able to make certain inferences of people by studying the hardware they are going to operate or maintain, even in the blueprint stage. The earlier QPRI starts, the better its results.

These inferences are the product of the knowledge gleaned from these many factors of the current Air Force Personnel System: personnel procurement and assignment, career management, USAF job structure, training and training devices, handbooks and other job aids and proficiency evaluation.

All of these, coupled with the three ingredients of personnel and training knowledge and theory, hardware characteristics, and weapon system operations concept, allow the following inferences to be made of the weapon personnel sub-system: new aptitudes, retrainability, technical education, new AFSs (Air Force Specialty Code—re-designation of MOS), special training devices, position-oriented handbooks and personnel readiness tests.

Meshing QPRI

Since QPRI is only two years old, it has not yet been exploited to its fullest by being integrated into a weapon system from the very beginning of the system, therefore, some of the following is still theoretical.

Ideally, this is how and where QPRI should tie into a system, where its emphasis should be brought to bear during the system's development cycle and when QPRI should logically taper off to concentrate its efforts on other weapon systems.

Genesis of a weapon system is called a DPO—Development Planning Objective. This springs from considerable interplay between USAF and ARDC and takes the form of numerous exploratory and feasibility studies.

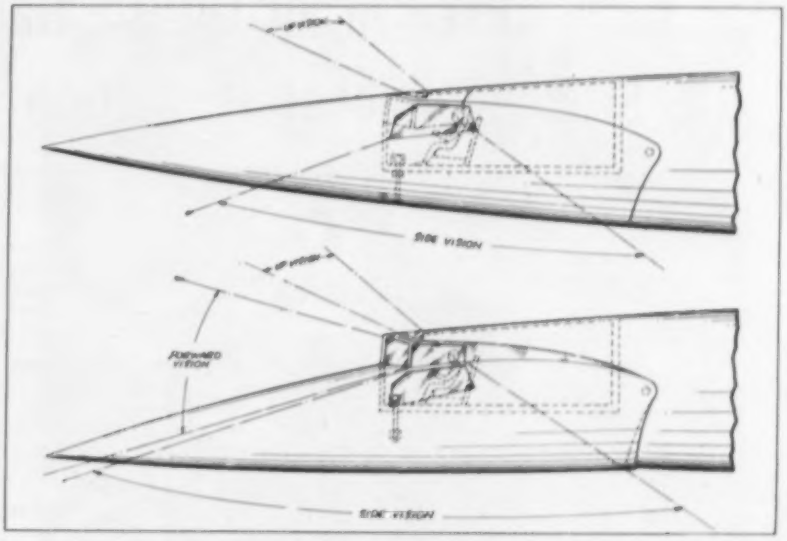
Project Progress

Then the project moves into the GOR, or General Operational Requirement plan which is issued by the Air Force. This still rather nebulous project is then firmed up into an SR—System Requirements—study issued by ARDC. At this point contractors are asked to participate and give their proposals on the weapon system in question within six to nine months.

It is also at this point that QPRI should enter the picture because the weapon system now starts into design studies and QPRI gives best results if it participates in a system from its inception.

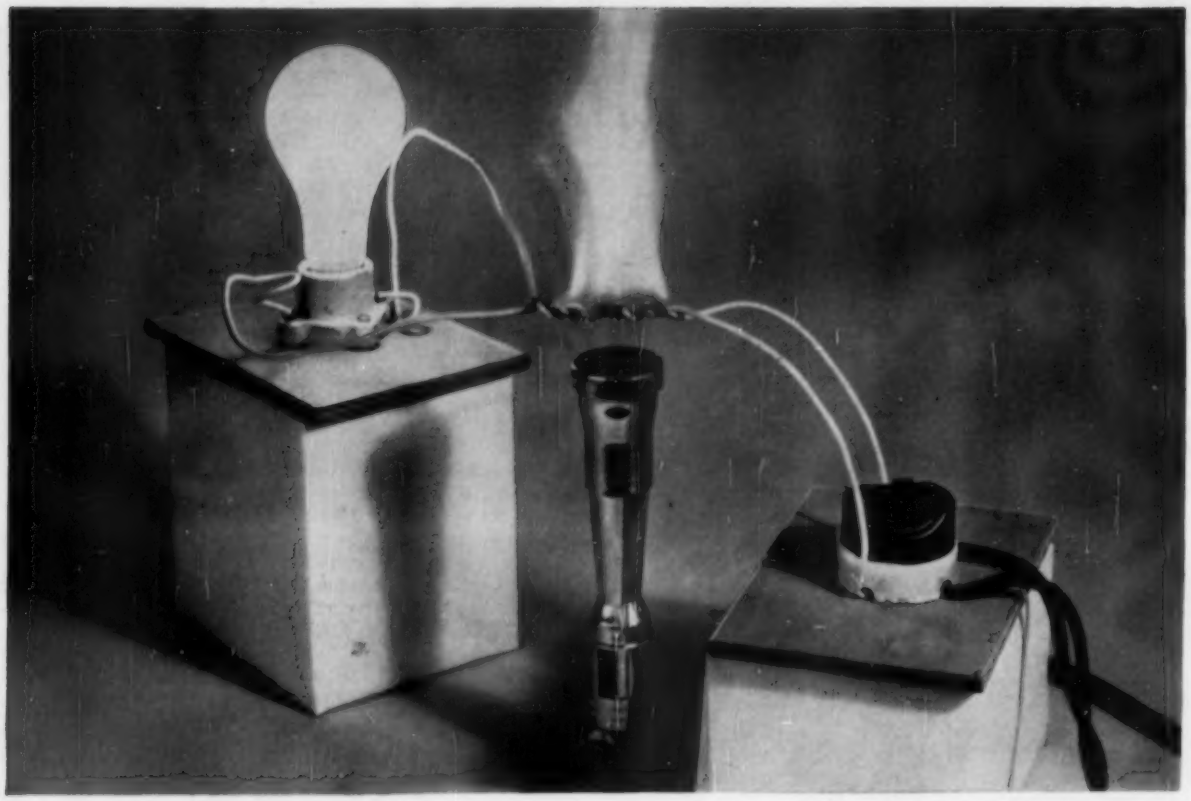
From here on activity within the Office of QPRI—and within all of AFPTRC—increases. Initial QPRI reports give first estimates of personnel requirements and possibly one or more manning tables.

AFPTRC makes human factor reports, including training requirement survey. ARDC centers also working on the project, such as Holloman, Kirtland



How to Increase Pilot Vision

Boeing patent shows whole ogive nose hinging down to uncover forward windshield for better pilot visibility when landing high-speed, highly streamlined aircraft. U. S. patent No. 2,778,586 also claims that ordinary bubble canopies set up sources for aerodynamic heating which no known windshield material can withstand. A Republic patent, U. S. No. 2,781,183, describes a capsule in which the pilot is raised by an elevator mechanism inside streamlined confines of a high-performance airplane. Upon ejection same rails guide pilot in his downward escape. Republic's XF-103 is said to solve nose-high landing problem with periscope which pilot raises on landing approach.



Tests on aircraft wire prove

Even in an 1800°F flame, G-E Silicone Rubber Insulation still insulates

Exposed to an 1800°F flame for hours in the laboratory demonstration above, the G-E silicone rubber insulation did not fail. *No short circuit occurred in the wiring.* The silicone rubber formed a non-conducting ash of silicon dioxide which stayed in place despite tugging and vibration. Experts say there was no indication that the limits of the insulation were being approached in the test. This is just one example of the high temperature insulating properties of G-E silicone rubber—the reason it is being specified more and more for aircraft and missiles, such as in MIL-W-8777A.

Better performance in the air. G-E silicone rubber will not release toxic fumes at elevated temperatures as some insulating materials do. Its electrical characteristics are excellent, and it maintains nearly the same high dielectric strength at both high and low temperature extremes. Moreover, it keeps its original dielectric strength for years.

G-E silicone rubber stays flexible down to −75°F (special grades stay flexible down to −150°F). Other desirable performance features are low moisture absorption, ozone resistance approaching that of mica, and resistance to oil and fuel splashes.

Better, Faster Assembly in the plant. Since miles of wire go into a plane, the ability to handle well can save many hours of assembly. Silicone rubber strips cleanly and easily. It will not shrink when a soldering iron is applied. Colors are bright, for easy color identification.

Section R3J7, Silicone Products Dept.
General Electric Company, Waterford, New York

Please see that I receive all available information on the application of aircraft wire insulated with G-E silicone rubber, including a list of qualified wire and cable manufacturers.

Name_____ Position_____

Company_____

Address_____

City_____ Zone_____ State_____

Look into all the facts about silicone rubber wire, *for the cost is only slightly more than the cost of standard aircraft and ignition wire — much lower than other high-temperature wire.* Send for further technical data and names of manufacturers.

GENERAL ELECTRIC

Silicone Products Dept. Waterford, N. Y.

or Cambridge, are all hardware-oriented. AFPTRC is the only man-oriented center.

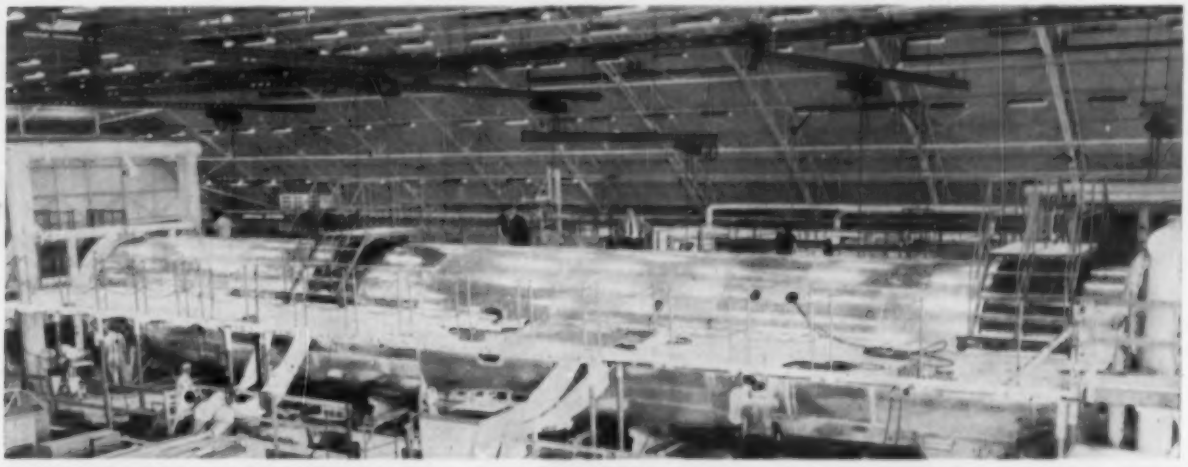
Contractors' data pours into AFPTRC, which is given only a few weeks to report its opinion of their concepts. The center determines which contractor concepts appear to be the most desirable from many standpoints: maintainability, ground support, operation and performance as it applies to selection and training of operating and maintenance crews, what new training methods and courses will be required, are these new skills within the Air Force's job repertoire, can men be up-graded to these new jobs or retrained or will training have to start from the beginning because the new jobs are so strange that there is no precedent.

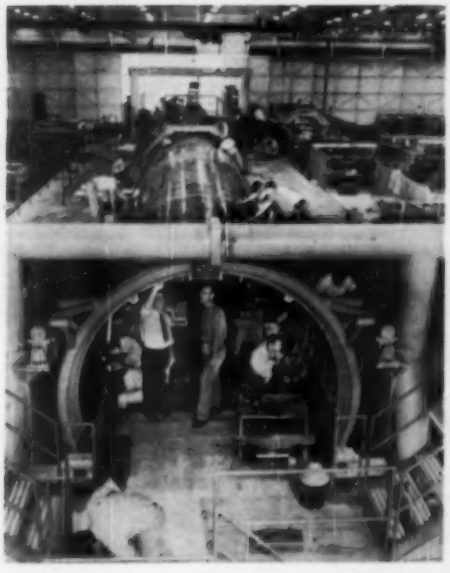
Next step in the weapon system's development cycle is DD–Development Directive–issued by USAF followed by SDD–System Development Directive–issued by ARDC. During this stage, called the development period, the system progresses through preliminary operations plan to mock-up. Some 60 days prior to mock-up stage, QPRI change reports are issued stating what it requires in the way of personnel support for the weapon system.

As the weapon system progresses through its final development stages–research and development testing, and production for inventory–and moves into such commands as Air Training Command and Air Proving Ground Command, QPRI responsibility and work load phases off. During this period, its chief products are change reports issued to the weapon system's using agencies.

QPRI may offer alternative use plans for the weapon system.

Responsibility of QPRI in a weapon system ceases when the latter completes phase VIII in its development. Phase VIII is "Extension of phase VII testing (which involves employment and suitability testing of the system under actual or simulated combat and climatic conditions) at an operational base under actual field operating conditions





Electra Assembly Moves Ahead

Assembly of the complete fuselage (top) of the first Lockheed Electra turboprop transport is finished at Lockheed's Burbank, Calif., plant. Wing attachment point is visible near center of photograph under catwalk. Quarter panels are joined (left, below) in the 94 ft. mating dock. Part of tubular dock structure supporting fuselage is visible. Mating of mid-section panels in jig is carried out (right, below). Boom in center supports panel while alignment is made. First Electra fuselage has now reached final assembly stage and pressurization tests have been completed on it. The airplane will roll out in December and fly in January. Installation is beginning of the four Allison 501 turboprop engines in the wing nacelles. Six airlines have ordered 133 Electras.

SUNDSTRAND
First in Constant Speed Drives
BOEING
DC-8
DOUGLAS

Two new jetliners will use Sundstrand Drives for 400-cycle electrical systems

America's first jet airliner, Boeing's 707 and the Douglas DC-8, will use 400 cps constant-frequency electrical systems powered from the engine and driven by Sundstrand Constant Speed Drives. While electrical system design details vary among the jetliners—safety, reliability, and simple operation are the criteria that directed the choice of Sundstrand Drives. Their ability to provide an electrical system supplying continuous power under all conditions with little or no monitoring by the crew also was an important factor. The ability to parallel generators—automatically, if desired—means Sundstrand Drives provide an electrical system offering improved equipment performance and utmost reliability, plus sufficient capacity for emergency operation. These growing commercial airliner applications reflect the growing record for reliability that keeps Sundstrand *first* in constant speed drives.

ONE OF MANY MODELS

This "Package-Type" unit is typical of the type of Sundstrand Constant Speed Drives that will be used on the two new jetliners. Each will have a custom-engineered drive that is ideally suited to its specific space, weight, mounting, and kva requirements.

SUNDSTRAND AVIATION

Division of Sundstrand Machine Tool Company • ROCKFORD, ILLINOIS

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AEI motors with their custom designed gear assemblies deliver shaft speeds from 1/10 to 5,000 RPM . . . according to your requirements. These dependable units have long been used in tuner assemblies, camera drives, radar sets, aircraft flap and landing gear assemblies; wherever specific speeds and torques are required.

Gear assemblies, either spur or planetary type, clutches and brakes are built into one compact, trouble-free unit. Special shaft configurations such as slotted, keyed, pinion, flat and others are available. The motors used are normally 400 cycle (higher frequencies available) and are built to withstand extreme temperature, shock and vibration conditions. All units meet military and other applicable specifications.

When you need a dependable power and gear package, AC or DC you can rely on American for both design and deliveries. Write for Bulletin 26-JE.

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Have you heard about the amazing engineering opportunities at AMERICAN?

with typical personnel and typical maintenance facilities."

However QPRI interest in the weapon system continues as long as it is operational.

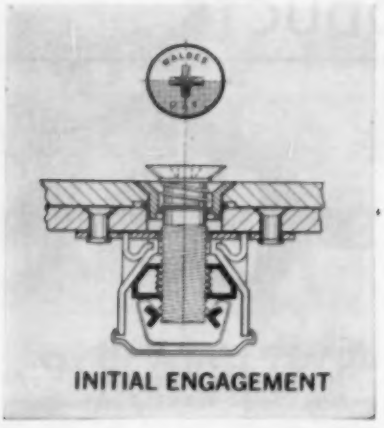
These are the Air Force agencies which will use QPRI weapon system reports and the uses they will have for the data:

- **USAF**—Air Force will use them for writing AFS (Air Force Specialties Code); for organization and manpower planning; for preparation of training guidance and for validation of special training device requirements.
- **ARDC**—Air Research and Development Command can use the data to help in the consideration of personnel and training factors in weapon system design and contractor selection; support special training device development; support research and development testing of new weapon systems and anticipate personnel and training research requirements.
- **AMC**—Air Materiel Command can use the reports in the preparation of logistics plans, technical orders and handbooks.
- **APGC**—Air Proving Ground Command will use the data in the preparation for employment and suitability testing.
- **Using Command**—Weapon system's using command can utilize the reports to prepare final operational plans, including tables of organization and unit manning documents and for command training planning.

(The second part of this two part series on QPRI will appear next week.)

900F Fasteners

Standard Pressed Steel Co., Jenkintown, Pa., has announced a line of 900F aircraft fasteners claimed as better at that temperature than current MS-20004 series fasteners at room temperature. The new Hi Tm 9 fasteners are made from Vascojet 1000, a 5% chromium hot work die steel made by Vanadium-Alloys Steel Co., Latrobe, Pa. SPS quotes a minimum tensile strength of 170,000 psi at 900F. Design features include large radius thread root, diffused nickel-cadmium plating, special locknut configuration. Initial production of Hi Tm 9 fasteners will be limited to 12-pt. external wrenching type aircraft tension bolts. Diameters will range from ¼-1½ in.



INITIAL ENGAGEMENT

QAF Fastener Joins Stressed-Panel Race

Latest stressed-panel fastener designed to meet requirements of the National Aircraft Standards Committee of the Aircraft Industries Assn. is the Waldes Kohinoor QAF.

QAF is like a conventional bolt fastener with a four lead thread but uses a split nut so that the stud can be quickly pushed in. The end of the stud trips a lever device which causes the two nut halves to wedge into engagement with the stud thread. Torquing the fastener causes further wedging action as the two halves are bottomed down inside the receptacle housing.

According to Waldes, the new fastener meets all the important requirements listed in NAS 547, the AIA specification which outlines target attributes for a stressed panel fastener. The QAF has been flight tested on the aft fuselage of a B-47 bomber.

However, William S. Clark, Temco Aircraft Corp., Dallas, Tex., who is head of the fastener committee, says that to his knowledge none of the seven fastener companies now trying to meet the NAS 547 specification have been fully successful.

A problem which has arisen in the high performance aircraft for which the NAS 547 type fastener is intended is in getting the access panels back in place after they have been removed. On the B-58 bomber the access panels in the engine pods are structurally so much a part of the general stressed skin supporting the engine weight that the pods actually droop after the panels have been removed. When the mechanic attempts to replace the panels, he finds it practically impossible to get the fasteners back into their receptacles without jacking up the engine pod.

Samples of the fastener may be obtained from Waldes Kohinoor, Inc., Long Island City, N. Y.

two horse-power

. . . yet only 3" x 6½"

Here is the most powerful electric motor for its size and weight made today. Weighing only 6¾ lbs., this latest American motor conforms to standard military specifications and is available in a wide variety of configurations to meet your needs. The unit is totally enclosed and explosion-proof. It is offered in single or three-phase, 400 cycle, 115/120 V, and performs with full efficiency under high temperature and shock conditions. Available with brake or clutch, fan or blower, standard or special shaft and gear accessories or straight drive.

1/200 H.P. Sub-Miniature Mtr., Frame 100
This unit, only 1" x 1½" and weighing 3 oz., is widely used as a component in electronic systems or timing devices. It is totally enclosed and meets military specifications. The motor is available with a variety of gear boxes and accessories; either induction or synchronous, 1 or 3 phase, 400 cycle, 115 V.

Shown here are only two of the wide range of motors produced by American. Special types can be engineered for your particular needs. Write for technical information.

AMERICAN ELECTRONICS, INC.
Miniature Components Division, Los Angeles 22
MARKETING DIVISION
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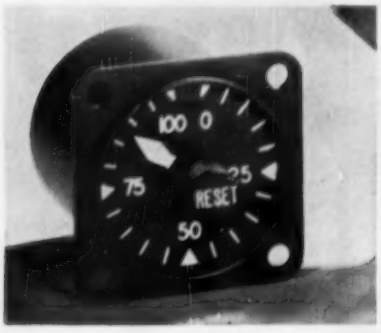
Other products manufactured by American Electronics include: Motor Alternators and Power Supplies; Electrical Ground Support Units; Electric Motors; Resolvers; Servo Motors; Nuclear Instrumentation and High Fidelity Tape Recording Systems.

NEW AVIATION PRODUCTS



Weapon Rounds Counter

Model PR-1 rounds counter, designed to USAF specifications for instrument panel mounting, receives pulses and displays percent remaining of predetermined number of rounds. Reset is made by a manual knob on the instrument. Unit weighs seven ounces. Variations of instrument, with pulse receiving rates up to 40 cps. and having electrical contacts and panel lighting are available.

Abrams Instrument Corp., 606 E. Shiawassee St., Lansing, Mich.

Oscillograph Records 16 Channels

Recording oscillograph which can record simultaneously up to 16 channels of phenomena at frequencies to 100,000 cps. on a single eight-inch record is a complete system with its own power supplies, pre-amplifiers, deflection amplifiers and recorder.

Eight dual-gun cathode ray tubes are used, and eight speeds, from three to 400 in./sec. may be selected. Records may be made varying in length from one to 50 ft. or up to 400 ft. on continuous roll. Unit measures 48-in. x 65-in. x 27-in.

Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.

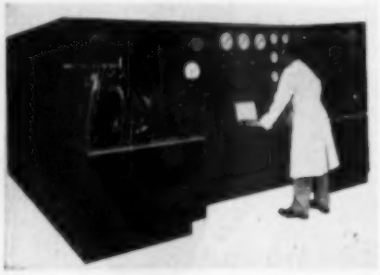
Fuel Control Test Stand

Jet engine fuel control test stand that provides time savings of 30% in checking out this type of equipment has been developed in cooperation with Pratt & Whitney Aircraft and the military.

Major features of the new unit are:

- **Automatic programming** of certain test stand operations to specified requirements.
- **Automatic data recording** system that graphically displays, during the test, the operating performance curves of the fuel control unit.

Operations are done simultaneously;



acceleration and deceleration of the test is preset and the test started by pressing a button. Test can be stopped if there is a need for adjustment.

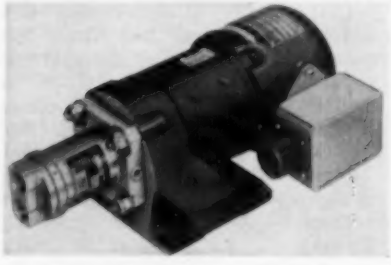
Fuel pump is driven by a 125-hp. variable-speed motor, held to an accuracy of .25%. Designated Model 7930, unit measures 12 ft. sq., is made up of five sections.

George L. Nankervis Co., 15300 Fullerton, Detroit 27, Mich.

Miniature Inertia Switch

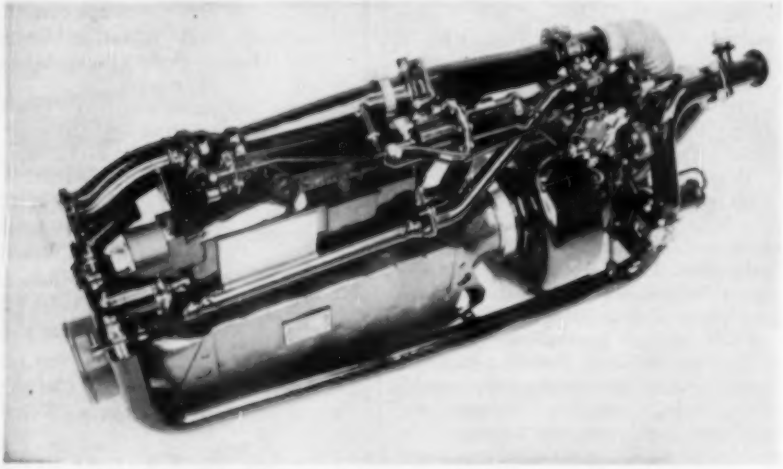
Inertia switch of one-half inch cubic volume and weighing three-quarter ounce has one moving part that momentarily closes electric contacts following impact or acceleration above a preset value. Unit is adjustable from 1.5G to 4G, tolerance ±.15. Other units to special specifications are also available.

Safe Lighting, Inc., 527 Lexington Ave., New York 17, N. Y.



Miniaturized Motor Pumps

Miniaturized motor pump designed for missile applications is designated Model AA-19054, is capable of deliver-



F-104 Air Conditioner Weighs 47 Lb.

Hamilton Standard's compact air conditioning and pressurizing package for new Lockheed F-104A Starfighter measures 38 in. long x 14 in. high x 8 in. wide. Weighing 47 lb., the unit delivers 35 lb./min. of air to the supersonic fighter's cockpit and electronic equipment. It is in production at firm's Windsor Locks, Conn., plant.

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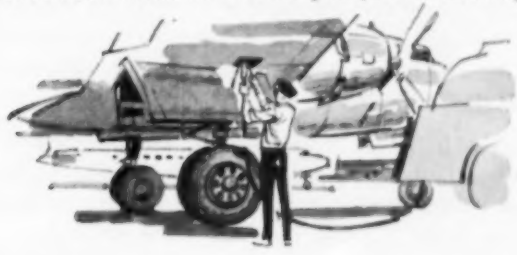

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ing 0.84 gpm. at 7,400 rpm. and 1,000 psi. Hydraulic pump's weight is one pound and electric motor weighs seven pounds. Overall length of both pump and motor is 9½ in.

Starting torque is less than 10% over maximum running torque. Electric motor for this model is a 28-v. d.c. unit rated at 0.84 hp.

Vickers, Inc., Detroit, Mich.

Long-Life Time Delay

Betachron F nuclear-powered fixed interval time delay is 2¾-in. x 1¾-in. hermetically sealed 0.4 lb. unit with long shelf life and 25-yr. use life. Nuclear battery with associated circuitry provides delays from milliseconds to 40 hr. with an accuracy of ±3% over a temperature range of −65F to 165F. Energy of 200,000 ergs is provided at a standard connector.

Universal Winding Co., P. O. Box 1605, Providence, R. I.

Pressurizing Stand

High pressure dry air or other gases for aircraft and missile systems or starting turbine engines is provided by Model KC-1037 Air Stand which has a four-stage compressor delivering 15 scfm. of dry air at pressures to 5,000 psig.

Dryness of −65F or lower dewpoint is maintained by an automatic dryer. An ICC-3AA 6,000-lb. cylinder is included for gas storage. For rocket and missile applications, there is equipment to boost nitrogen to 5,000 psig.

Kahn & Co., Inc., 541 Windsor St., Hartford 1, Conn.

Molded Current Transformer

Molded current transformer for aircraft has a 250/2-amp. current ratio and operates on 115-v. three-phase four-wire 400-cycle systems. Weighing less than 13 oz., unit is designed to operate in −55C to +170C and conforms to MIL-T-7210 for Type D-2 current transformers.

It measures 3.25 in. wide and high and has a hole diameter of 1.12 in. minimum.

Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.

Electric Circuit Analyzer

Automatic electric circuit analyzer for aircraft is designed to test 1,200 different circuits for shorts in less than a minute, according to Republic Aviation Corp., which developed the equipment for jet aircraft production line use. Company says that it plans to manufacture and market it.

Analyzer is applicable to virtually any multiple circuit assembly. Here's how it functions: A harness is plugged in, the operator presses a starter button and electric current passes in succession through each circuit in the assembly. As each circuit is checked, a light flashes on a panel board perforated with from 100 to 1,200 lights, each representing

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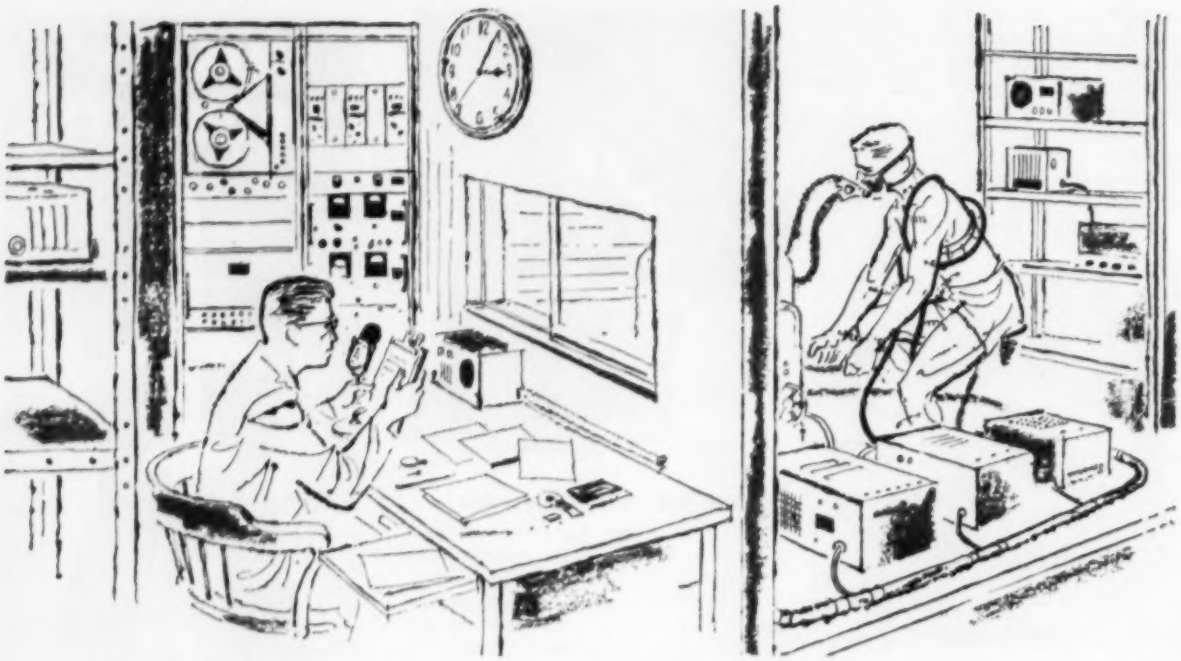


PUTTING BODY RESPONSES ON TAPE SPEEDS RESEARCH IN HUMAN PHYSIOLOGY

Q: How do environmental conditions affect the total physiology of a human being?

Q: What are the effects of age, sex, health, etc., on work performance, and what range of variation can be expected within each group?

Q: How does the body regulate temperature and respiration under varying environmental conditions and exercises?

The answers to the questions posed above cannot be found in the literature. Why? Not too little data, but far too much . . . so scattered that it cannot be brought together for integration and analysis. Now, strides forward in the techniques of automatic data handling may help scientists provide the answers.

Consider the problem posed by the study of a man repeating a simple manual task. The force he exerts can be measured by placing him on a ballistic platform. But ten minutes of experiment might easily necessitate a full day of computation. Repeating the experiment in other environments multiplies the days of computation. To study the effect of fatigue on his performance means a full day of experiment in each environment . . . months of computation. A significantly large number of subjects assures valid conclusions, but means scores of man-years of mathematics. And integrating body temperature, heart rate, etc., into your results requires scores more.

The availability of large computers has now made such analysis conceivable. But only the development of magnetic tape data recording has made it feasible.

Magnetic tape is the vital link between experiment and computer. Accepting electrical signals from measuring instruments, it stores the information for long periods of time . . . plays it back in exactly the same form . . . the one language all electronic data analysis equipment understands. It further offers the facility of high data storage density. Far more data can be economically stored than a single typical experiment demands, and the surplus data used in future studies. Portability permits data recorded on the spot to be analyzed a continent away with no loss of time or accuracy.

The techniques of magnetic tape data recording were first developed less than a decade ago by the Davies Laboratories Division to solve similar problems in the field of aircraft vibration analysis. The first systems specifically designed for physiological research have just recently been placed in operation. Designed for flexibility, they economically meet initial demands for data capacity, yet may be expanded at little expense to satisfy changing requirements. Up to thirty-six individual tracks of data can be simultaneously recorded . . . and interchangeable electronics permit recording each kind of data by the most desirable technique . . . Direct, FM, or PWM. Up to six recording and playback speeds can be chosen at the flip of a switch for data expansion or contraction. The same system will play back data to associated analysis equipment, or the reel can be shipped to remote analysis facilities.

Considerable information on magnetic tape data recording and how it might be best applied to your data recording, reduction, and analysis needs is provided in our Bulletin 1001, available on request to Minneapolis-Honeywell Regulator Company, Davies Laboratories Division, 10721 Hanna Street, Beltsville, Maryland. WEbster 5-2700

MINNEAPOLIS **Honeywell**

DAVIES LABORATORIES DIV.

a circuit. The checker stops automatically at the end of a successful check; if there is a reversed or open circuit, the checker stops at that circuit and the light indicating that line remains on, all other circuits involved are also located.

Also available as optional equipment is a device to check the leakage of current through wire insulation.

Republic Aviation Corp., Electronics Division, Farmingdale, N. Y.

New Oil Tank Shutoff

Made of aluminum except for sump cover, oil tank shutoff valve is designed to replace conventional all-steel unit in Douglas DC-8 and Lockheed Electra turbine-powered transports.

Submerged in oil, it surpassed Civil Aeronautics Administration heat test requirements by remaining operational after 2,000F of flame was applied for

32 min., the manufacturer reports.

Unit is designed for manual and motor actuation in 1¼, 1½ or 2-in. line sizes with four to six-in. sump covers and for engine oil tanks and constant-speed oil tanks. Equipment illustrated provides for gate operation by cable in synchronization with other units.

Wm. R. Whittaker Co., Ltd., 915 N. Citrus Ave., Los Angeles 38, Calif.

WHAT'S NEW

Reports Available

The following publications are available from the Office of Technical Services, U.S. Department of Commerce, Washington 25, D. C.:

One Method for Measuring the Solvent Resistance of Crystal-To-Crystal Adhesive Bonds—by B. J. Faraday and D. J. G. Gregan, Naval Research Laboratory. $.50; 8 pp. (PB 121582)

The AC Resistance of Sintered Titanates—by M. C. Andrews and E. K. Weise, University of Illinois for Air Research and Development Command. $.50; 6 pp. (PB 121421)

The Selection of Materials for High-Temperature Applications in Airframes: Supplement—by S. A. Gordon and L. R. Jackson, Battelle Memorial Institute. $.75; 30 pp. (PB 121602)

The Corrosion of Titanium—by D. W. Stough, F. W. Fink, and R. S. Peoples, Battelle Memorial Institute. $4.75; 184 pp. (PB 121601)

A General Summary of the Physical Metallurgy of Titanium Alloys—by R. I. Jaffee, Battelle Memorial Institute. $2.25; 83 pp. (PB 121603)

The Elastic Constants in Structural Design with Particular Application to Titanium—by S. A. Gordon, Battelle Memorial Institute. $1.00; 34 pp. (PB 121600)

Surface Treatments of Low Alloy Steels—by Sam Tour, and Co., Inc., for Wright Air Development Center. $5.00; 261 pp. (PB 121507)

Research on Elevated Temperature Resistant Ceramic Structural Adhesives—by R. M. Spriggs, H. G. Lefort, and D. G. Bennett, University of Illinois for Wright Air Development Center. $2.50; 99 pp. (PB 121659)

Investigation and Development of High-Temperature Structural Adhesives—by A. S. Kidwell and K. L. McHugh, The Connecticut Hard Rubber Company for Wright Air Development Center. $2.00; 75 pp. (PB 121657)

Stress Corrosion Cracking in Type 403 Stainless Steel—by M. G. Fontana, The Ohio State University Research Foundation for Wright Air Development Center. $1.50; 59 pp. (PB 121414)

A Simple, Objective Test for Cable Noise Due to Shock, Vibration or Transient Pressures—by T. A. Perls, National Bureau of Standards. $.75; 24 pp. (PB 121583)

A Large Barium-Titanate Accelerometer for Shock-Velocity Measurements—by T. A. Perls and C. W. Kissinger, National Bureau of Standards. $.50; 19 pp. (PB 121584)

The Air Force Program for Improved Flight Instrumentation—by L. C. Wright, Wright Air Development Center. $1.25; 44 pp. (PB 121763)

PRESSURE SYSTEMS ENGINEERS

Wallace O. Leonard, Inc., has designed and manufactured check valves for many different types of pneumatic and hydraulic applications. The check valve described below, which is available in various sizes, has a far greater flow capacity than AN fittings of comparable size. This series is but a part of the Leonard line of lightweight, reliable devices for regulating, controlling and measuring pressure or flow.

LEONARD CHECK VALVE
155000 SERIES

Operating pressure range:
up to 3,000 PSI
Temperature range: −65° to +225°F
Maximum weight: 0.08 pounds

your inquiry is invited

For additional information on this series of check valves, or consultation on your needs for similar products, please write, wire or telephone the nearest Leonard representative listed below. Their experienced sales engineers will be pleased to assist you.

IN SEATTLE—Associated Industries, 1752 Rainier Avenue, Seattle 44, Wash. Telephone Minor 4400 or TWX SE-202.

IN WICHITA—Associated Industries, Inc., 455 South Washington, Wichita 7, Kan. Telephone HObart 4-0391 or TWX WI-266.

IN GREATER NEW YORK—Brierley, Davis Company, 332 Springfield Avenue, Summit, N.J. Telephone CRestview 3-7300 or TWX Summit NJ 355.

IN SOUTHERN CALIFORNIA—Control Components Company, 35 North Arroyo Parkway, Pasadena, Calif. Telephone RYan 1-5172 or TWX Pasa Cal 7175.

LEONARD PASADENA

Wallace O. Leonard, Inc.
373 South Fair Oaks Avenue, Pasadena, Calif.

PRODUCTION BRIEFING

Thompson Products, Cleveland, Ohio, has secured license rights to use the "Flotrusion" cold flowing process of the Claude C. Slate Co., Glendale, Calif.

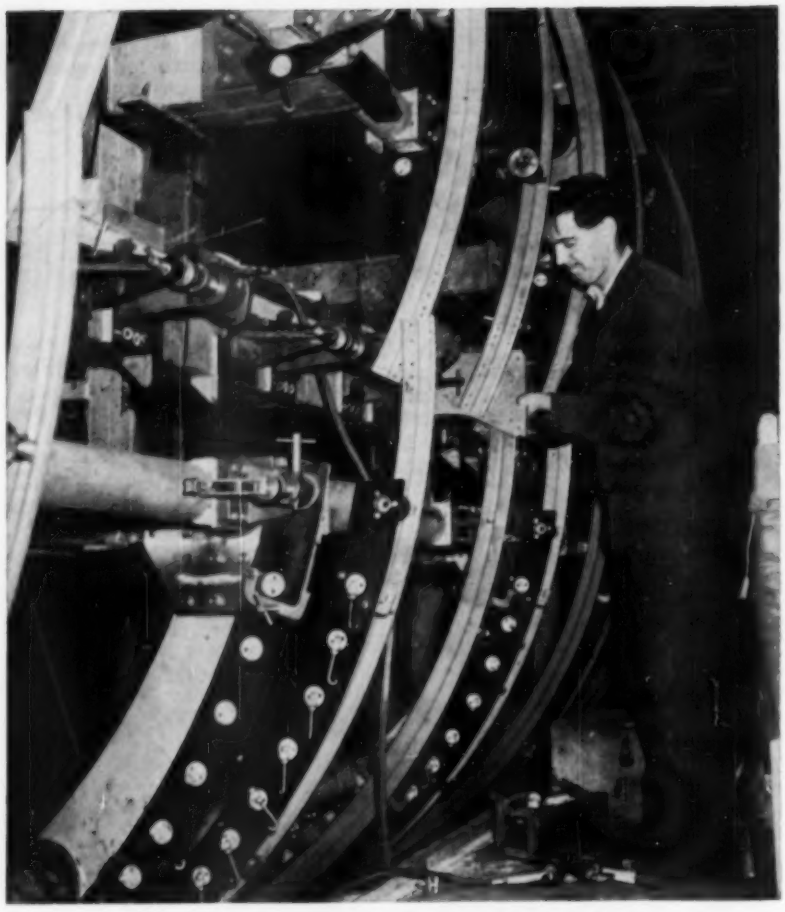
American Machine and Foundry will build privately owned research reactor for SORIN, a nuclear development company jointly owned by the Italian industrial groups, Fiat and Montecatini. Reactor will be a one megawatt pool type. Since Fiat is building its own design of aircraft gas turbines, this raises possibility Fiat will eventually be one of the first Italian companies to consider nuclear powered aircraft.

Owens-Corning Fiberglas Corp.'s Ashton, R. I., reinforced plastics laboratory is starting an 18-month technical development research program for USAF's Air Materiel Command, Dayton, Ohio. The program will investigate glass reinforced plastics for high-temperature applications.

Bell Aircraft Corp., Buffalo, N. Y., has acquired 350 acres of land near Pembroke as a site for its proposed Lawrence D. Bell Research Center. Initial expenditure for the research building is expected to be $1 million. The first unit will be a hypersonic wind tunnel capable of handling the highest speed ranges. This will be followed by a laboratory for heat studies. All services and facilities of the new center will be available to other manufacturers. This center plus a new warehouse and a recently completed $750,000 building to house the electronic data processing center will increase the total Bell Niagara Frontier valuation to more than $34 million, President Leston Faneuf said.

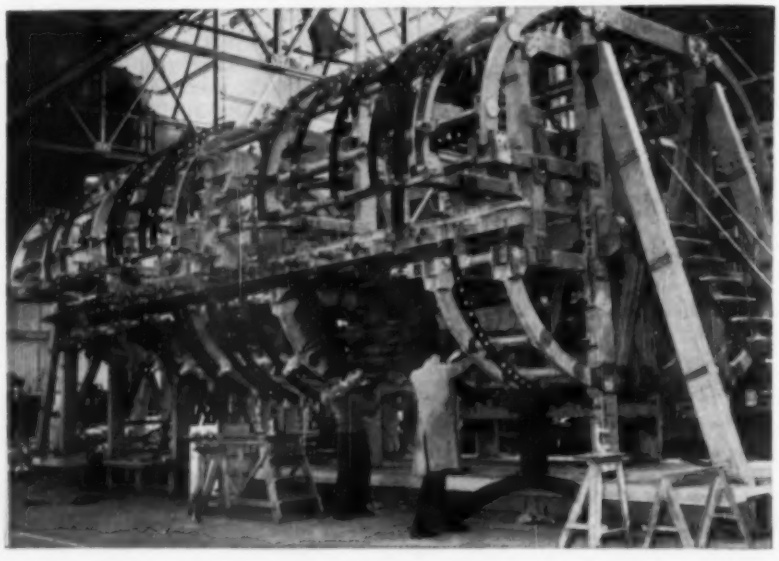
North American Aviation's Rocketdyne Division, Canoga Park, Calif., jointly financed a $650,000 wind tunnel with USAF to be used to study the behavior of rocket nozzles at altitude. The two-foot wide test chamber will be used to observe the flow of cold rockets as it expands against various back pressures.

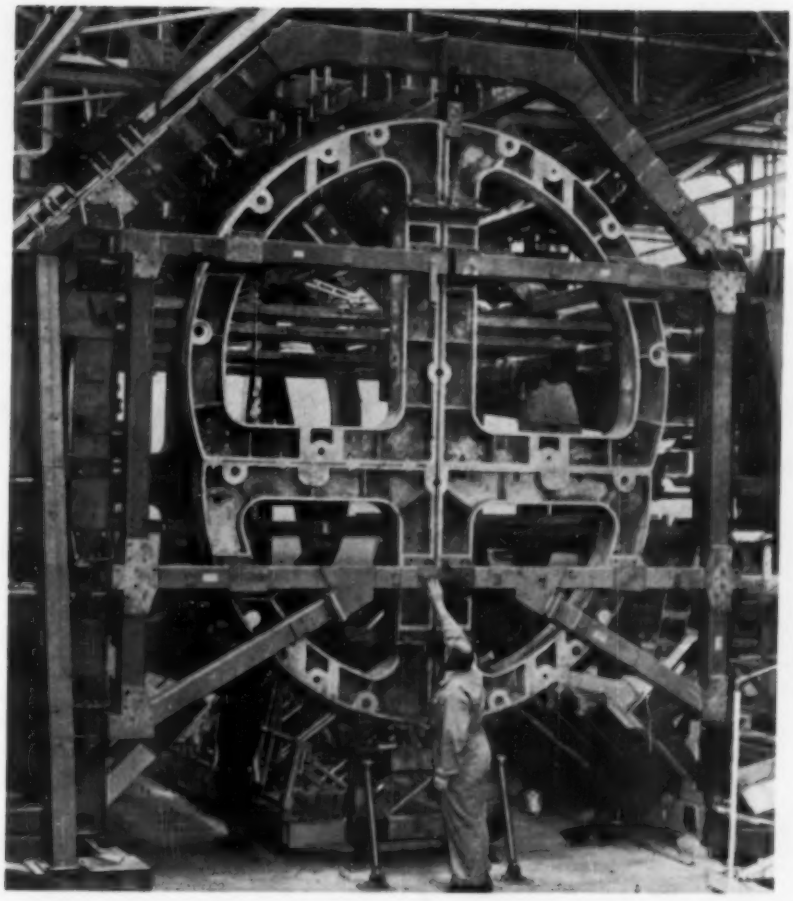
Curtiss-Wright Corp. has been licensed by the Atomic Energy Commission to construct a 1,000 kw. pool-type research reactor. C-W will build the $2,470,000 reactor at its Quehanna, Pa., research center. After completion towards the end of 1957, the reactor will be used by the C-W atomic division to study shielding, reactor components, instrumentation, radiation damage, neutron physics and isotope production. Also in progress at C-W

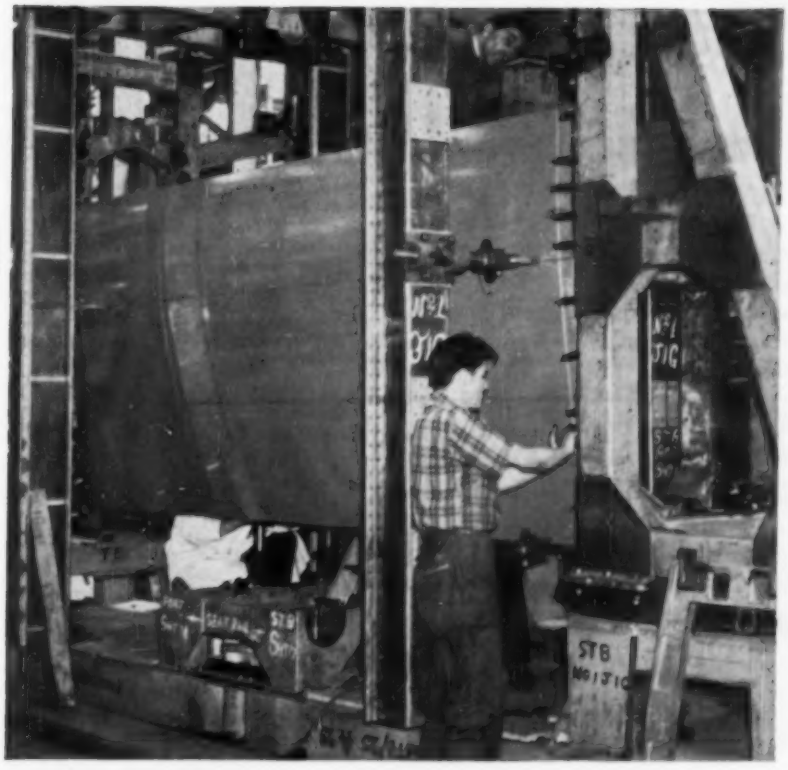


Vickers Vanguard Takes Shape

Workers at Vickers-Armstrongs plant, Weybridge, England, assemble first turboprop Vanguard. Aircraft is one of 20 ordered by British European Airways, with initial flight scheduled for fall of next year. Vanguard "double bubble" fuselage is made in five sections (below), built in vertically divided halves. Intermediate jigs are used to join the halves before final fuselage assembly. Wing construction is based on torsion boxes which are assembled in jigs (lower right). Trans-Canada Airlines also has 20 Vanguards on order.







is a $650,000 contract to CDC Control Services, Inc., Hatboro, Pa., to design, construct and install a full-scale jet engine test facility control system. The CDC system will be used to run the present air supply and ten test cells at C-W's Wright Aeronautical Div., Wood-Ridge, N. J.

Rohr Aircraft Corp., Chula Vista, Calif., has opened a $500,000 assembly plant at Auburn, Wash., near Boeing Airplane Co.'s Transport Division at Renton, Wash., for which Rohr produces KC-135 power packages. Rohr claims to be the first large subcontractor to set up shop near its customers. The company has a similar plant near Lockheed's C-130 plant at Marietta, Ga.

New engineering service organizations formed recently are Resco, Inc., Sandy Springs, Ga., and Dikewood Corp., Albuquerque, N. M. Resco is composed of about a dozen engineers, mostly aeronautical. Dikewood comprises a smaller group with particular interests in the field of systems analysis.

Air Reduction Co., Inc., is adding a new $\$4\frac{1}{2}$ million polymer laboratory to its central research facilities, Murray Hill, N. J. Present fields of investigation at the Airco laboratories are chemistry, metallurgy and cryogenics (study of effects of very low temperatures). Air Reduction also plans to build a $9 million air liquefaction plant at Acton, Mass. When completed in summer 1958, it will produce 75 tons of liquefied oxygen, nitrogen and argon gases per day. Similar plants are being constructed at Los Angeles and Chicago.

Precision Castparts Corp., Portland, Ohio, has completed a new $125,000 investment casting and shell molding plant. The firm specializes in alloy and stainless steel parts for aircraft, missiles and electronic manufacturers.

National Gas Turbine Establishment, Pyestock Hants, England, is installing a compressed air drying plant capable of handling 200 lb. of air per second. To be used in a NGTE jet engine altitude cell, the dryer uses 30 tons of dessicant in two cylinders 10 ft. in diameter and 25 ft. long.

Nuclear flight facility contract at Idaho Falls, Idaho, was let to Howard S. Wright Construction Co., Seattle, Wash. The $6 million contract covers a large test building, two-story control and equipment building, miscellaneous supporting buildings, shielded roadway, four-rail dolly trackage, transmission line substation and contaminated

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waste systems. The flight engine test installation will be located in the Aircraft Nuclear Propulsion area of Atomic Energy Commission's National Reactor Test Station. Facility will be used to test nuclear engines in conjunction with airframes, typical crew compartments and control systems. The contractor will be allowed about two years to complete the work.

General Electric's Small Aircraft Engine Dept., Everett, Mass., is getting a $500,000 furnace facility. Six electric and gas fired furnaces along with various gas producing and purification

equipment will be used for the solution treating, age hardening, stress relieving and brazing of jet engine components. Largest is a 93 ft. roller hearth furnace.

Denison Research Foundation, Powell, Ohio, a non-profit corporation has been organized to help ameliorate the engineering shortage by providing research facilities in electronic, mechanical, metallurgical, ceramic and managerial fields.

Tapered Air Products Corp., Lynwood, Calif., announces a 56% increase in first quarter sales over the same quarter of last year. The 125-employe company reports a backlog in excess of $3 million for milled, integrally-stiffened wing skins. Recently announced contracts include orders for Convair's F-102A and the Lockheed Electra.

Convair Division of General Dynamics Corp., San Diego, Calif., is constructing a $680,000 facility for the adhesive bonding of integral wing fuel tanks for the Convair 880 transport at San Diego. The Scotchweld process jointly developed by Convair and the Minnesota Mining and Manufacturing Co. for use on F-102A delta wings will be used to join the 120 ft. 880 wing. A $178,000 electric oven, 80 ft. long by 20 ft. high by 10 ft. wide, to be supplied by the Despatch Oven Co., Los Angeles, will accommodate two 880 wing tank sections for the curing operation. In the curing oven 325F heat will melt and cure the flat Scotchweld epoxy resin tape into a fuel resistant adhesive barrier between the wing joints.

General Electric and the Detroit Arsenal, Center Line, Mich., have been working on a system for observing the workings of enclosed cyclic mechanisms. Called stroboradiography, the process involves long exposures of a series of X-radiation bursts synchronized to the repeating motion of the mechanism.

Boeing has begun testing its supersonic wind tunnel. Test section is 4 ft. by 4 ft., and speed range is from Mach 1 to Mach 4.

Low-Cost Simulators For Civil, Military

Complete line of custom-built simulators covering civil and military aircraft for flight and maintenance crews is being developed to meet low budget requirements by Les Jones Training Aids, Inc., Van Nuys, Calif.

Instructor's station has controls to introduce malfunctions in aircraft systems. Students' panels contain all instrumentation needed for normal and emergency procedures. Firm is also developing mobile training units, cutaways, films and related training devices.

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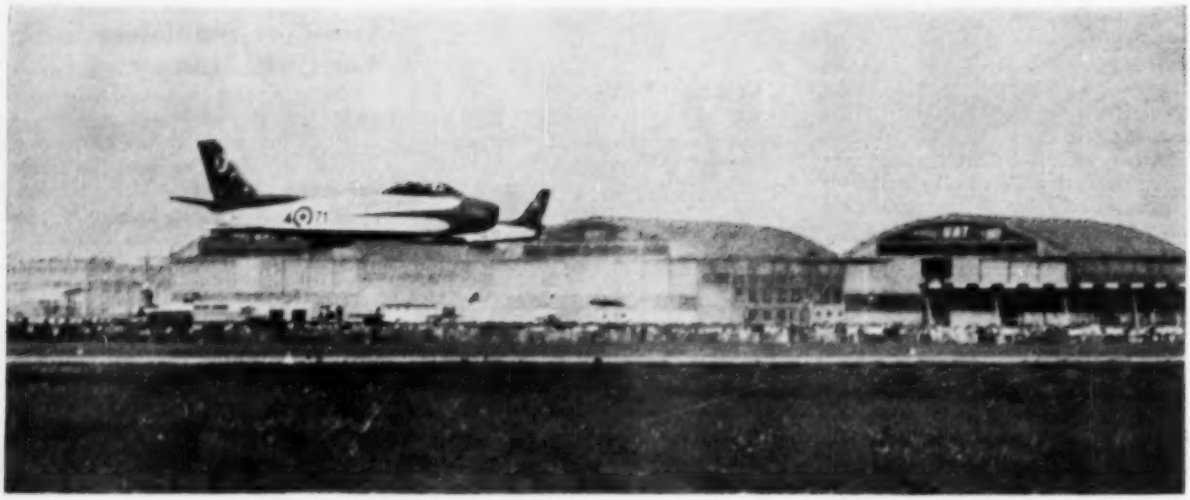

Italians Execute Head-on Pass

Two of the four plane Italian acrobatic team, using Canadair Sabre IVs, complete a head-on pass over Le Bourget Airport at the Paris air show. Other two planes crossed the field in similar pass at right angles. Team also made spectacular tight formation landing (AW June 17, cover).

AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts for $25,000 and over as released by the Air Material Command.

Small Aircraft Engine Department, General Electric Co., West Lynn, Mass., $12,213,300 for product improvement for J-85 series engine.

General Electric Co., Cincinnati, $4 million for GE-5 turbojet A/C engines.

Seymour Wallas & Co., St. Louis, Mo., $1,880,402 for webbing assemblies.

Westinghouse Electric Corp., Friendship Airport, Baltimore, $1,882,713 for radar sets, equipment data, and services.

Century Engineers Inc., Burbank, Calif., $1,703,270 for trainer devices.

Weston Electrical Instrument Corp., Newark, N. J., $1,212,586 for indicators, spare parts and data.

Airesearch Manufacturing Co. Division, The Garrett Corp., Los Angeles, $1,037,777 for overhaul and modification of turbine compressor.

Allison Division, General Motors Corp., Dayton, $13,456,805 for propellers and components.

A/C Spark Plug Division, General Motors Corp., Milwaukee, $3,340,000 for facilities in support of the ballistic missile program.

Otis Elevator Co., Brooklyn, N. Y., $2,230,547 for bombing and navigational radar trainers, spare parts, data and ground handling equipment.

Solar Aircraft Co., San Diego, $1,284,202 for gas turbine generator sets and burner assembly.

Sperry Gyroscope Division, Sperry-Rand Corp., Great Neck, L. I., N. Y., $1,298,518 for all attitude flight data systems, data and reports.

Aerojet General Corp., Sacramento, Calif., $1,219,742 for facilities.

Federal Manufacturing and Engineering Corp., Garden City, N. Y., $1,143,414 for modulator power supply.

B. F. Brown Co. Inc., Chicago, $1,069,813 for operating dining halls, kitchens and food processing facilities.

CAA Contracts

Washington—Following is a list of contracts as released by the Civil Aeronautics Administration:

Bendix Radio Division, Bendix Aviation Corp., Baltimore, $395,876.52 for airborne weather radar, ADF (automatic direction finders), marker beacons and audio amplifiers to equip 12 DC-3 flight inspection aircraft.

Sperry Gyroscope Co. Division, Sperry Rand Corp., Great Neck, L. I., N. Y., $330,699.10 for gyropilot equipment for 12 DC-3 flight inspection aircraft.

Collins Radio Co., Cedar Rapids, Iowa, $215,193.72 for airborne VOR localizer and glide slope receivers, VHF communications receivers and transmitters and miscellaneous navigational instruments for 12 DC-3 flight inspection aircraft.

Weston Electrical Instrument Corp., Newark, N. J., $237,686.95 for electronic 315 tube analyzers.

Raytheon Manufacturing Co., Waltham Mass., $105,738.60 for four dual video mappers for use with long range installations.

Consolidated Diesel Electric Corp., Stamford, Conn., $73,172 for 15 diesel engine generators and spare parts.

Bird Electronic Corp., Cleveland, $68,287.37 for directional detectors.

Collins Radio Co., Cedar Rapids, Iowa, $59,450 for VHF navigation receivers and glide slope receivers.

Weston Electrical Instrument Corp., Washington, $44,445.48 for flight inspection meters and omni-mag indicators for use in 12 DC-3 flight inspection aircraft.

George Voron & Co., Philadelphia, $41,400 for portable VOR detector units.

C. Lorenz Aktiengesellschaft, West Berlin, Germany, $35,740.50 to tropicalize VOR units.

King-Knight Co., San Francisco, $34,371 for three engine generators and spare parts.

George Voron & Co., Philadelphia, $34,206.58 for VHF detectors.

Remmert-Werner Inc., St. Louis, $25,779.78 for radomes and shielding material for installation of weather radar in 12 DC-3 flight inspection aircraft.

Hevi Duty Electric Co., Milwaukee, $20,534.76 for two constant current regulators.

Circuit Breaker Co., Philadelphia, $16,040 for 20 circular polarization kits and spare parts.

Polarad Electronics Corp., Long Island, N. Y., $8,360 for two spectrum analyzers.

Huggins Laboratories, Henlo Park, Calif., $4,837 for six electronics tubes.

Red Bank Division, Bendix Aviation Corp., Red Bank, N. J., $1,183.80 for four electronics tubes.

Penn Camera Exchange, Washington, $1,054.12 for photographic equipment.

Eastern Steel Products Corp., Rocky Mount, N. C., $164,066.07 for 42 units of counterpoise framing.

Navy Contracts

Following is a list of unclassified contracts of $25,000 and over as released by Navy Contracting Offices:

AVIATION SUPPLY OFFICE, 700 Robbins Ave., Philadelphia 11, Pa.

American Machine and Metals Inc., United States Gauge Div., Clymer Ave., Sellersville, Pa. Pressure transmitters (PREN 11-1321-57), various $47,941.

Glenview Electronics Corp., 1619 S. Bowling Green Drive, Woodcrest, Haddenfield, N. J. Test oscillators and parts (24/75022/57), various, $33,966.

Container Research Aviation Inc., 3513 West Chester Pike, Newton Square, Pa. Rotor blade helicopter containers (IFB-383-1623-57), various, $52,562.

Scintilla Div., Bendix Aviation Corp. Converters, harness assys., magneto ignition (383/2118-5021/55), various, $222,686.

Airpath Instrument Co., Lambert Fd., St. Louis 21, Mo. Magnetic compasses (IFB-383-1537-57), $3705 ea., $81,510.

Wright Aeronautical Div., Curtiss-Wright Corp., Wood Ridge, N.J. Services and material containers for gear boxes (383/23055-58pl/57), various, $33,450.

Patten Co. Inc. 1803 N. 10th Ave., Lake Worth, Fla. Pneumatic rafts (MIPR-36-600-7-20B-38), 1362 ea., $277,401.

Pesco Products Div., Borg-Warner Corp., 24700 N. Miles Rd., Bedford, Ohio. Gears and couplings (383/2118-223/53), various, $93,625.

United States Gauge Div., American Machine and Metals Inc., Clymer Ave., Sellersville, Pa. Transmitters (IFB-383-1407-57), various, $35,771.

Bill Jack Scientific Instrument Co., Solana Beach, Calif. Helmet assys. (383/29045-88G3/3/57), 746 ea., $77,853.

Bendix Products Div., Bendix Aviation Corp., S. Bend, Ind. Services to overhaul and repair JFC model pumps (383/23055-17P6/1/57, 383/2118-214/53) various, $654,686.

United States Gauge Div., American Machine & Metals Inc., Sellersville, Pa. Indicators (IFB 383-1712-57), 2,674 ea., $102,040.

Sperry Gyroscope Co., Sperry Rand Corp., Great Neck, N. Y. Drive-motors (383/29041-6x6/1/57), various, $110,072.

Bendix Products Div., Bendix Aviation Corp., 401 Bendix Dr., S. Bend 20, Ind. solenoid & cover assys., screws, (383/2118-77/55), various, $51,750.

The Rubbercraft Co., of America, Inc.,

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by turning 3 tons with 13 pounds

The giant "saucer", rotating atop this Lockheed Super Constellation, contains an airborne radar antenna. It requires a high-power-to-weight ratio driving mechanism for the scanning operation. This mechanism must be compact, dependable, able to provide constant speed, regardless of load change . . . and operate in a position remote from the aircraft power supply.

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Drive components include:

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- Fixed displacement hydraulic motor for driving the radome.

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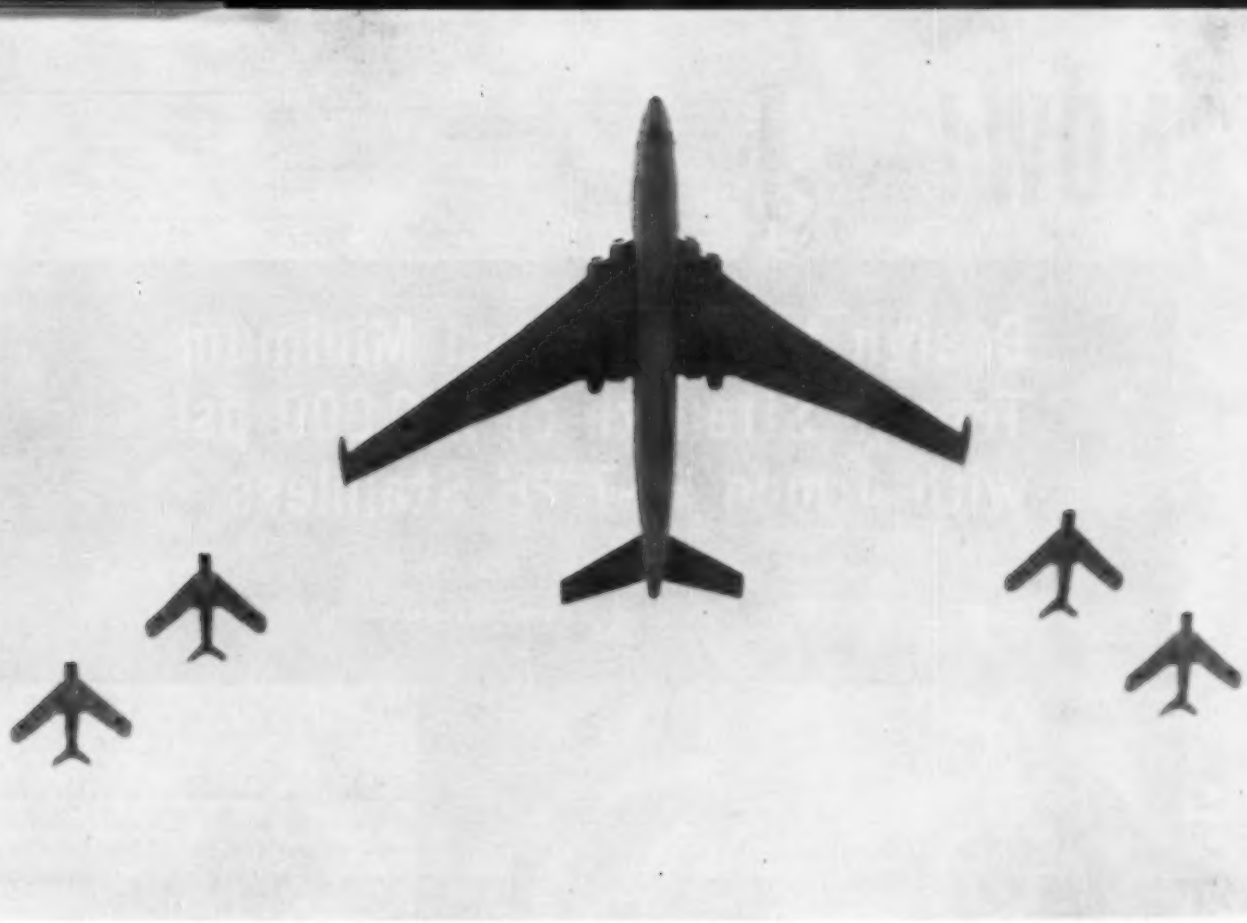


Bison Flies in Red Parade

Escorted by four MiG-17 Fresco fighters, Russian Bison strategic bomber powered by four Lulko turbojet engines parades over Moscow's Red Square. Unusually clear photo shows canted engine tail pipes to avoid Coanda effect, nose installations for bombing and reconnaissance. Belly markings indicate bomb bays are located forward near engine intakes and just aft of exhausts.

151 Orange Ave., W. Haven, Conn. Life preservers (210/7002/57), 4,500 ea., $121,500.

14TH NAVAL DISTRICT, Navy #128, Fleet P. O., San Francisco, Calif.

Hawaiian Dredging & Construction Co., Ltd., 1350 Ala Moana, Honolulu, Hawaii, additional aviation facilities, hangar and aircraft parking area, U. S. Naval Air Station, Barber's Point, (IFB NBy 8007) $3,185,000.

Giuli Construction Co. & A. C. Chock, Ltd., 822 Mapunapuna St., Honolulu, Hawaii, aircraft parking area, U. S. Marine Corps Air Station, Kaneohe Bay, (IFB NBy 8076) $345,700.

NAVY DEPARTMENT, BUREAU OF ORDNANCE, Washington, D. C.

Alfred Hofman & Co., West New York, N. J., 25-lb. practice bomb, Mk 76 Mod 2, NOrd-17760, IFB 600-859-57-0, 600,000, $2,724,000.

USAF Contracts

Following is a list of unclassified contracts for $25,000 and over as released by Air Force Contracting Offices:

SACRAMENTO AIR MATERIEL AREA, McClellan AFB, Calif.

Roylyn, Inc., 1706 Standard Ave., Glendale 1, Calif. Items used for support of the MA-2 MPSU to check electrical system of the F-100 and F-104 series aircraft; various quantities (PR 2445), $348,894.

Consolidated Diesel Electric Corp., spares to MA-1 & MA-2 MPSU (PR 2446) $285,591.

AIR FORCE CAMBRIDGE RESEARCH CENTER, ARDC, Hanscom Field, Bedford, Mass.

Texas A & M Research Foundation, College Station, Tex., development of techniques of forecasting micrometeorological variables, AF19(604)-2250, $67,000.

WRIGHT AIR DEVELOPMENT CENTER, Wright-Patterson AFB, Ohio.

American Potash & Chemical Corp., 3030 W. Sixth St., Los Angeles 54, Calif., 45,500 lbs. trimethylborate 70% and 136,000 lbs. trimethoxyboroxine, colorless liquid, (IFB-33-616-57-43), $87,511.

SHELBY AF DEPOT, Wilkins AF Station, Shelby, Ohio.

Welsh Mfg. Co., 9 Magnolia St., Providence 9, R. I., glasses, sun, spectacle type P-2 plastic frame with carrying case, 25,570 pr. (IFB 33-602-57-187), $62,669.

Aeroquip Corp., 300 South East Ave., Jackson, Mich., hose assembly, 4,435 ea. (RFP 33-602-57-3052), $154,393.

Engineering and Mfg. Co., 611 N. 40th St., Philadelphia 4, Pa., filler and bleeder hydraulic system truck mounted, USAF Type MA 1, $934 ea. Maintenance data, 1 set, (IFB 33-602-57-84), $315,444.

OGDEN AIR MATERIEL AREA, Hill AFB, Utah.

Bendix Aviation Corp., Bendix Products Div., 401 N. Bendix Drive, South Bend 20, Ind., components, parts for strut assy F84-D,E,G, aircraft, (PR 60-7-03G-21), $386,769.

American Machine & Foundry Co., Electronics Div., 1085 Commonwealth Ave., Boston 15, Mass., modification kits and data for AFG-T1A trainers, (PR's 60-504812, 504812-2, and 60-504812-3), $165,776.

Bendix Aviation Corp., Bendix Products Div., 401 N. Bendix Drive, South Bend 20, Ind., miscel. aircraft wheel and brake parts, (PR 60-7-03B-15), $1,110,075.

Columbus Jack Corp., 220 S. Third St., Columbus 7, Ohio, clevis assy., 24,035 ea., ring assy., 7,186 ea., release assy., tow target, mech. operated, 16,000 ea., vertebrae and tip assy., 12,000 ea., (IFB 42-600-57-250), $175,052.

Goodyear Tire & Rubber Co., 1144 E. Market St., Akron 16, Ohio, miscel. aircraft wheel and brake parts, (PR 60-7-03B-308), $146,164.

Bendix Aviation Corp., Bendix Products Div., 401 N. Bendix Drive, South Bend 20, Ind., spare parts for aircraft wheels and brakes, (D. Ofl on contract AF 42660-18225), $109,098.

TOPEKA AIR FORCE DEPOT, Topeka Air Force Station, Topeka, Kans.

Dow Chemical Co., Midland, Mich., reprocess and repackage Bromochloromethane including makeup of material loss in reprocessing in airborne fire extinguishing equipment, 1,429,700 lbs., $62,192.

Acme-Newport Steel Co., Ninth and Lowell Sts., Newport, Ky., low carbon steel sheet, (IFB 14-604-57-845), 865,900 lb., $70,163.

Reed and Prince Mfg. Co., 1 Duncan Ave., Worcester 1, Mass., screw steel, (IFB 14-604-57-871) 14100 C, $53,812.

Aviation Developments, Inc., 210 S. Victory Blvd., Burbank, Calif., quick release pin (RFP 14-604-57-5605), 16,500 ea., $49,935.

Screw Corp. of Calif., 5565 Valley Blvd., Los Angeles, Calif., screw, 23440 C (IFB 14-604-57-854), $52,230.

Aer-O-Line Mfg. and Supply, 3110 Winona

NOW!

Design to Guaranteed Minimum Tensile Strength of 210,000 psi with Armco 17-7 PH Stainless

New heat treatment for 17-7 PH offers unusually high minimum guaranteed properties, creates new opportunities in aircraft and missile design

Here are the guaranteed minimum properties for Armco 17-7 PH in Condition RH 950 at room temperature:

Ultimate tensile strength, psi.....210,000
0.2% Tensile yield strength, psi.....190,000

These properties, plus retention of high strength at temperatures up to 900 F, make Armco 17-7 PH Stainless Steel one of the strongest aircraft materials on a strength-weight basis.

Strength at Elevated Temperatures

Armco 17-7 PH is already used in many of America's supersonic aircraft and long range missiles on the basis of 180,000 psi minimum ultimate and 150,000 psi minimum yield (Cond. TH 1050). The new and much higher minimum properties for Condition RH 950, plus excellent strength at elevated temperatures, indicate the material's potential in combating the heat and stresses of supersonic speeds.

Typical Short Time Properties of 17-7 PH Sheet & Strip—Condition RH 950

TENSION	75F	400F	800F
Ultimate, psi	235,000	204,000	171,000
0.2% Yield, psi	220,000	186,000	144,000
Elong., % in 2 in.	6	4	8
COMPRESSION			
0.2% Yield, psi	227,000	198,000	—
BEARING			
Ultimate, psi	460,000	—	—
2% Yield, psi	375,000	—	—

Fabrication, Heat Treatment Simple

Armco 17-7 PH simplifies the design and production of aircraft components because it is fabricated in the easily-worked annealed condition and then hardened. Production men in the industry have found the material is readily stretch-and-press-formed, drawn and welded; that it simplifies tough jobs and in many cases has helped cut production costs considerably.

Condition RH 950 properties are fully developed by this simple hardening treatment: Heat at 1750 F for 10 minutes and air cool; hold at — 100 F for 8 hours; and heat at 950 F for 1 hour and air cool.

Consider how the unusual combination of properties offered by Armco 17-7 PH Stainless Steel . . . high strength, resistance to heat, excellent fabricating characteristics and corrosion resistance . . . can be utilized to help solve your design and production problems.

For additional information on Armco 17-7 PH Stainless and the new heat treatment, RH 950, write us at the address below.

(A companion grade, Armco 17-4 PH, is produced in bar, wire and billets.)

ARMCO STEEL CORPORATION

1777 Curtis Street, Middletown, Ohio

Sheffield Steel Division, Armco Drainage & Metal Products, Inc., The Armco International Corporation

Ave., Burbank, Calif., screw, 25500 C (IFB 14-604-57-854), $48,241.

General Motors Corp., Allison Div., Plant #5, Indianapolis, Ind., special tools and equipment for J-33 engines (RFP 14-604-57-5326) 3 ea., $52,425.

Elastic Stop Nut Corp. of America, 2330 Vauxhall Rd., Union, N. J., nut (RFP 14-604-57-5469) 397,280, $52,519.

Tube Distributors Co., Inc., 1415 Kellum Place, Garden City, N. Y., steel tubing (IFB 14-604-57-803) 4,032 ft., $62,475.

Howard Steel Fabricating Corp., 1221 South Plate St., Kokomo, Ind., steel bar and rod (IFB 14-604-57-826) 404,600 lbs., $85,498.

Avtron Manufacturing Inc., 10409 Meech Ave., Cleveland 5, Ohio, Avtron model T35 AC system tester, 31 ea.; Avtron model T31 DC system tester, 31 ea. (RFP 14-604-57-5472) $255,173.

MIDDLETOWN AIR MATERIEL AREA, Olmsted AFB, Pa.

Simmonds Aeroaccessories, Inc., 105 White Plains Rd., Tarrytown, N. Y., transmitter, indicator IFB PR MA-563837, 3,139 ea., $232,626.

Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark, N. J., multimeter RFP PR MA-651304, 13,283 ea., $309,493.

Air Reduction Co., Inc., Air Reduction Sales Co., 150 East 42nd St., N. Y. 17, N. Y., nitrogen IFB PR MA-662086, 20,000,000 cu. ft., $60,000.

Royal Contracting Co., Inc., 1114 Ave. Y., Brooklyn, N. Y., erection of AB-259 arctic type towers IFB PR (MAMN) 57-266-1, 2 ea., $58,290.

SAN ANTONIO R&D PROCUREMENT OFFICE, ARDC, Post Office Box 63, Lackland AFB, San Antonio, Tex.

Institute of Andean Biology, Lima, Peru, additional research and reports on mechanisms of natural acclimatization. (Contracts AF 18 (600)-174) Job—$70,000.

Univ. of Chicago, 5801 Ellis Ave., Chicago 37, Ill., research and reports to determine the consistency of rating of peer status. (Contract AF 41(657)-157 Job—$37,578.

GADSDEN AF DEPOT, Gadsden AF Station, Gadsden, Ala.

F. J. Stokes Corp., 5500 Tabor Road, Philadelphia 20, Pa., pump, vacuum, rotary type, size 105 cfm, 1200 rpm, 4310-267-4877 (IFB 01-608-57-65 and Amdt. 1), $239,676.

Stock Transactions

Washington—Acquisition of $50,000 in California Eastern Aviation Inc. 6% convertible debentures by Edward A. Kerbs, director, has been reported by the Securities and Exchange Commission. Kerbs' total holding is now $101,000.

W. W. Brinckerhoff, officer and director, disposed of 3,600 common shares, leaving a total holding of 80,013; Samuel J. Solomon, officer, acquired 2,300 common shares for a holding of 28,148 and S. J. Solomon & Sons, a beneficial owner, disposed of 3,200 common shares leaving a holding of 1,800. Other transactions from April 11 to May 10 include:

Aero Supply Manufacturing Co. Inc. Acquisition of 200 common shares by Harold E. Christensen, director, his total holding; Acquisition of 400 common shares by Chester L. Thompson, director, his total holding.

Aeroquip Corp. Disposal of 200 common shares by Charles Hollerith, officer and director, leaving a holding of 16,612.

Air Associates Inc. Acquisition of 500 common shares by Hal A. Kroeger, director, for a holding of 550.

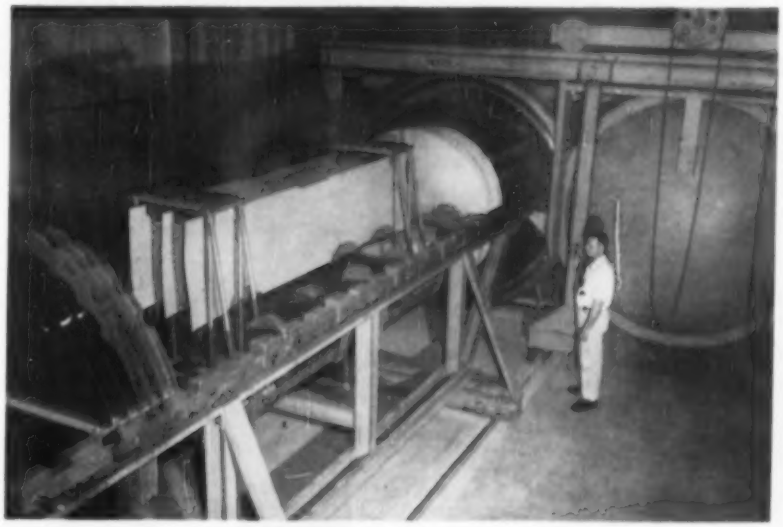
Air-Way Industries Inc. Acquisition of 11 common shares by Edward Lamb, officer, through Edward Lamb Enterprises, a beneficial owner, for a total holding by Lamb of 40,996 and a holding by Edward Lamb Enterprises of 57,191; acquisition of 100 common shares by Edward Lamb Enterprises, a beneficial owner, for a holding of 391,048 with the Unity Corp., a beneficial owner also, holding 685 shares.

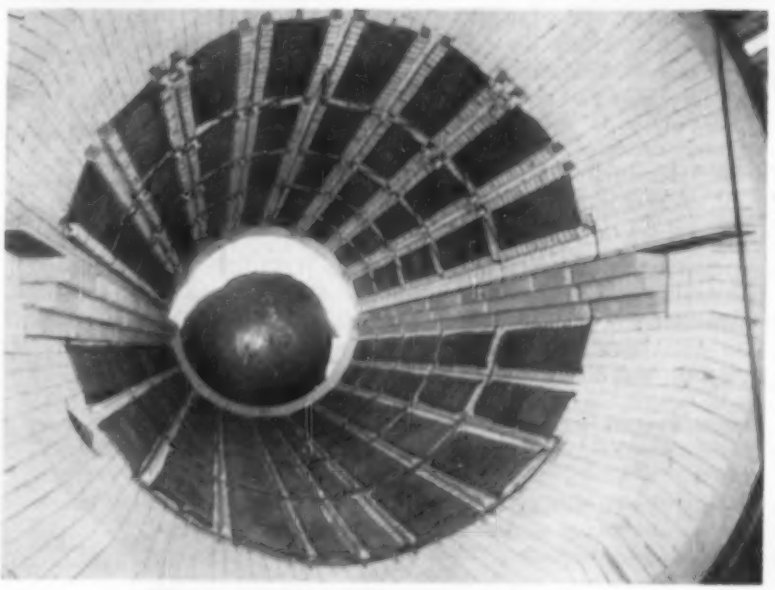
Acquisition of 780 common shares by Woodruff Inc., a beneficial owner, through Prudence H. Lamb, a beneficial owner, for a holding of 1,860; acquisition of 28 common shares by Edward Lamb Enterprises, a beneficial owner, through Prudence H. Lamb, a beneficial owner, for a holding of 109,685. Prudence H. Lamb, a beneficial owner, directly holds 50,463 shares and The Unity Corp., also a beneficial owner, through Prudence Lamb holds 4,712 shares.

American Airlines Inc. Disposal of 300 common shares by Amon G. Carter, director, leaving a holding of 9,400; acquisition of 100 common shares by Edwin H. Herzog, director, for a holding of 300.

American Bosch Arma. Acquisition of 100 class "A" common shares by John H. Flaskamper, officer, his total holding; disposal of 375 class "A" common shares by F. William Harder, director, leaving a holding of 7,500; acquisition of 100 class "A" common shares by Sidney E. Miller, officer, through exercise of option, for a holding of 940; disposal of 100 class "A" common shares by Kenneth H. Rockey, director, leaving a holding of 4,110.

Atlas Corp. Acquisition of 100 common shares by David A. Stretch, officer, for a holding of 2,300; acquisition of 100 option warrants by David A. Stretch, officer, for a holding of 2,000; acquisition of 4,344 5% preferred shares by Floyd B. Odlum, officer





Furnace Heat Treats Titanium

North American Aviation's Missile Development Div., Downey, Calif., used 820 kw. Lindberg vacuum furnace to heat treat titanium parts of the now canceled Navaho missile. Temperatures up to 2,100F and vacuum down to 0.3 microns are used to remove hydrogen impurities which would cause the metal to be brittle and crack under manufacture or later in operation.

HOW TO FLIGHT-TEST A METEOR IN YOUR LAB

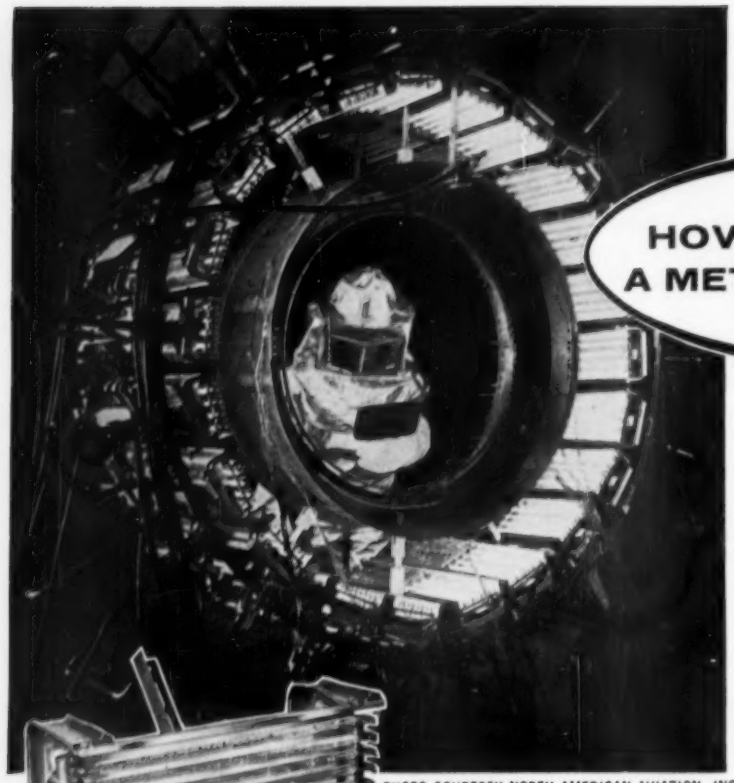
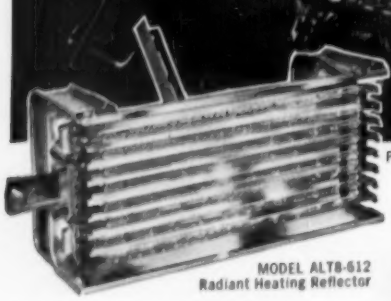


PHOTO COURTESY NORTH AMERICAN AVIATION, INC.



MODEL ALT8-612
Radiant Heating Reflector

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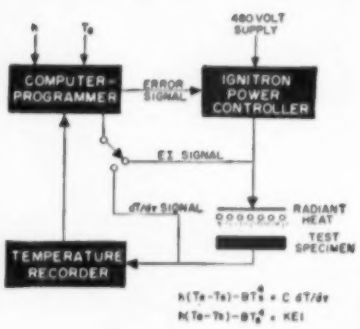
To determine airframe structural stresses and deflections under transient thermal conditions corresponding to supersonic flight.

PROBLEM

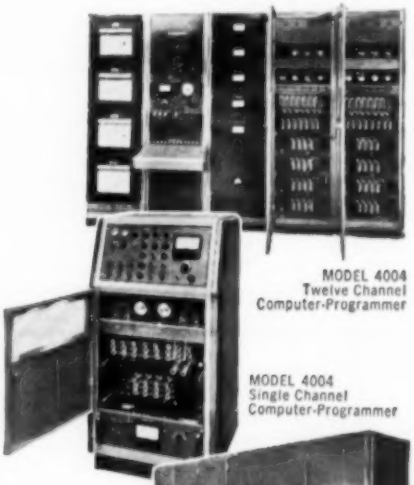
To simulate aerodynamic heating of aircraft structures with computer-scheduled heat input rates derived from basic aerodynamic parameters.

SOLUTION

Radiant Heaters, Computer-Programmers, and Ignitron Power Controllers designed and built by Research, Incorporated.



RADIANT HEATING REFLECTORS are available in many configurations to cover any shape or size area. Standard reflector units are capable of power densities of 48 kw/ft². Special reflectors are available for power inputs approaching 100 kw/ft².



MODEL 4004
Twelve Channel
Computer-Programmer

MODEL 4004
Single Channel
Computer-Programmer

MODEL 6145
Ignitron Power
Controllers
(350 kva each)

COMPUTER-PROGRAMMER, working from a heat transfer schedule based on a desired mission profile, solves the heat transfer equations and regulates heat flow into the test structure to correspond to actual transient flight conditions. It will also program temperature vs time, heat-flow vs time, and thermal soak conditions.

IGNITRON POWER CONTROLLER, responding to either manual or computer control, regulates electrical power to the reflector assemblies. Model 6145, with a power rating of 350 kva per unit controllable from 0.3% to 97% of full power, is typical of many power ratings and physical configurations that are offered.

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and director, for a holding of 104,000.

Avco Manufacturing Corp. Acquisition of 600 common shares by George E. Allen, director, for a holding of 1,500; acquisition of 500 common shares by Matthew A. McLaughlin, officer, for a holding of 675.

Braniff Airways Inc. Acquisition of 799 common shares by Fred Jones, officer, for a holding of 2,132.

Capital Airlines Inc. Disposal of 500 common shares by James R. Stockton, director, leaving a holding of 1,310.

Chance-Vought Aircraft. Acquisition of 1,000 common shares, through exercise of option, by H. B. Sallada, officer and director, for a holding of 1,200.

Continental Air Lines Inc. Disposal of 2,000 common shares by Robert F. Six, officer and director, leaving a holding of 5,000.

Curtiss-Wright Corp. Disposal of 1,800 common shares by James G. Byron, officer and director, leaving a holding of 5,700; acquisition of 5,000 common shares, through exercise of option, by Thomas C. Coyne, officer, for a holding of 10,000; acquisition of 2,000 common shares, through exercise of option, by Sam D. Irwin, officer, for a holding of 8,200; disposal of 1,200 common shares by Marion E. Jordan, Jr., officer, leaving a holding of 1,900.

Emery Air Freight Corp. Acquisition of 600 common shares by John C. Emery, officer and director, for a holding of 22,040.

Fairchild Engine and Airplane Corp. Disposal of 550 common shares by E. Ainsworth Eyre, director, leaving a holding of 500; acquisition of 500 common shares by William Preston Lane Jr., director, jointly with wife, their total holding. Mrs. Lane, as a beneficial owner, holds 600 common shares; Lane directly holds 1,600 common shares.

Flying Tiger Line Inc. Acquisition of 100 common shares by Oswald R. Burghardt, officer, for a holding of 425; acquisition of $10,000 worth of convertible debentures by John C. Cosgrove, director, total holding.

W. R. Grace & Co. John C. Griswold, officer and director, acquired 1,000 common shares for a holding of 5,000.

Lear Inc. Acquisition of 316 common shares as incentive bonus by Harold C. Andrus, officer, for a holding of 1,614; acquisition of 159 common shares as incentive bonus by F. D. Beamer, officer, for a holding of 325; acquisition of 137 common shares as incentive bonus by Robert H. Bloomberg, officer, for a holding of 257; acquisition of 309 common shares as incentive bonus by Albus Durham, officer, for a holding of 871.

Acquisition of 287 common shares as incentive bonus by Philip E. Golde, officer, for a holding of 13,562; acquisition of 473 common shares as incentive bonus by Andrew F. Haiduck, officer, for a holding of 8,144; acquisition of 168 common shares as incentive bonus by Albert C. Keske, officer, for a holding of 1,075.

Acquisition of 1,104 common shares as incentive bonus by William P. Lear, officer and director, for a holding of 423,246; acquisition of 736 common shares as incentive bonus by Richard M. Mock, officer, for a holding of 13,574; acquisition of 174 common shares as incentive bonus by Paul Moore, officer, for a holding of 778; acquisition of 185 common shares as incentive bonus by Albert A. Rorison, officer, for a holding of 748; acquisition of 239 common shares as incentive bonus by Chester D. Seftenberg, officer, for a holding of 510; acquisition of 173 common shares as incentive bonus by G. C. Warman, officer, his total holding.

McDonnell Aircraft Corp. Acquisition of 200 common shares by Robert H. Charles, officer and director, for a holding of 5,513.

National Airlines Inc. Acquisition of 100 common shares by Charles F. Sharp, officer, for a holding of 581.

Northwest Airlines. Acquisition of 1,100 common shares by A. J. Weatherhead Jr., director, for a holding of 2,650.

Nuclear Corp. of America. Disposal of 200 class A shares by K. H. Morganstern, officer, leaving a holding of 31,800.

Radio Corp. of America. Acquisition of 100 common shares by Robert L. Werner, officer, for a holding of 787; disposal of $3,200 worth of 3½% convertible sub debentures by Robert L. Werner, officer, his entire holding.

Seaboard & Western Airlines Inc. Disposal of 500 common shares by Arthur V. Norden, officer and director, leaving a holding of 61,113.

Trans Caribbean Airways Inc. Acquisition of 1,250 and disposal of 300 class A common shares by Irving M. Buckley, officer and director, for a holding of 1,899.

Trans World Airlines Inc. Disposal of 124 common shares by E. O. Cocke, officer and director, leaving a holding of 1,100.

United Air Lines Inc. Acquisition of 100 common shares by the son of Paul A. Bissinger, director, through Bissinger. The total number of shares, which are held beneficially held by Bissinger's son, are 100.

United Aircraft Corp. Acquisition of 2,500 common shares, through exercise of option, by William R. Robbins, officer and director, for a holding of 6,700.

Western Air Lines Inc. Acquisition of $2,000 worth of 4¼% convertible sub debentures by Dudley Swim, director, for a holding of $266,000.

Certificates of Necessity

Washington—Office of Defense Mobilization has awarded Pratt & Whitney Aircraft Division of United Aircraft Corp., East Hartford, Conn., a certificate of necessity for accelerated tax amortization in the amount of $4.7 million covering production of jet engines for military aircraft, with 75% of the rapid rate allowed. Other certificates awarded:

Eitel-McCullough, Inc., San Carlos, Calif., electronic tubes for military use, $2.2 million, certified with 40% allowed.

Cameron Iron Works Inc., Houston, missile components for military use, $558,290 with 40% allowed.

Boeing Airplane Co., Seattle, military aircraft, $879,592 with 65% allowed.

Boeing Airplane Co., Seattle, military aircraft, $669,246 with 65% allowed.

Bendix Aviation Corp., North Hollywood, Calif., military aircraft and missile components, $154,105 with 65% allowed.

The Martin Co., Baltimore, military aircraft, $753,152 with 65% allowed.

Ryan Aeronautical Co., Inglewood, Calif., military aircraft components, $81,325 with 65% allowed.

Ex-Cell-O Corp., Elwood, Ind., military jet engine components, $75,706 with 65% allowed.

Kearfott Co. Inc., Black Mountain, N. C., military aircraft instruments, $2,063 with 65% allowed.

Sundstrand Machine Tool Co., Denver, military aircraft components, $485,380 certified with 50% allowed.

Waldorf Instrument Division, F. C. Huyck & Sons, Huntington Station, N. Y., military aircraft parts, $270,043 certified with 65% allowed.

Ryan Aeronautical Co., San Diego, military jet engine parts, $67,671 certified with 65% allowed.

Friez Instrument Division, Bendix Aviation Corp., Towson, Md., scientific instruments for military use, $66,045 certified with 65% allowed.

Aircraft Products Co., Bridgeport, Pa., military aircraft parts, $40,925 certified with 70% allowed.

J. C. Peacock Inc., Los Angeles, military aircraft components, $318,831 certified with 60% allowed.

Ryan Aeronautical Co., San Diego, military aircraft engine parts, $244,651 certified with 65% allowed. Military aircraft and parts, $270,000 certified with 60% allowed.

General Laboratory Associates, Norwich, N. Y., military aircraft parts, $89,000 certified with 45% allowed.

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Write for interesting brochure on engineering opportunities.

Student Growth Sparks School Expansion

By Erwin J. Bulban

Teterboro Airport, N. J.—Expansion of pilot and mechanic training facilities is underway here by Teterboro School of Aeronautics to meet expanding business volume that has been growing better than 10% annually in recent years.

In its fiscal year ending May 31, the school grossed approximately $364,000 compared to $317,000 the previous year. It expects to show a volume about 10% higher in the current fiscal year. Additional services made possible by the facilities expansion are expected to increase this even further in the future.

CLASSROOM BUILDING will also hangar school planes. It can be expanded (dotted line).

School Area

When it opens for operation by the end of this year, the school's new classroom, shop and hangar structure will cover about 15,000 sq. ft. Current quarters, which it will retain, embrace some 6,000 sq. ft. New building is being erected by Port of New York Authority at a cost of approximately $350,000.

The school will rent its new quarters for about $3,000 monthly.

Not only will the new structure permit Teterboro School of Aeronautics to reorganize its operations, swollen well beyond present capacity, it will also provide for expansion into new fields. President Don Hulse and Vice President Dave Van Dyke feel strongly that the contacts generated by the school are a prime sales source that they have had to neglect because of pressure of training and lack of adequate facilities. With additional modern area, they aim to seek distributorships for a lightplane and aircraft equipment.

Aircraft sales, now confined to used and rebuilt planes, overhauled at its shops, have been an irregular operation by the school. Hulse and Van Dyke told AVIATION WEEK that every year the school receives scores of serious inquiries from students and other potential customers seeking second-hand aircraft.

They feel that some of these potentials and some of the businessmen-students would constitute a good market for new planes as well.

Both were extremely critical of the industry for not providing new, two-place, low-cost lightplanes for what they feel is a good present market potential for this class. What is this market willing to spend? Approximately $3,500 to $4,000 for an all-metal type, they say, judging from the numerous contacts they have had with private pilots. Configuration would resemble the Cessna 120-140.

Largest enrollment in the school is for its aircraft and engine mechanics courses; there are some 218 students studying days (18 months for a total of 2,160 hr.) and 150 in the night school (36 months) compared to about 200 signed up for private and commercial pilot courses.

Direct Mail

Direct mail selling plays an important role in getting students. Last year the school made some 20,000 mailings to students of New York and New Jersey high schools, working from lists supplied by these institutions. All but about 10% of the schools in this area cooperate in furnishing such material. Returns on mailings average about five to eight per cent; the school manages to close about two per cent of these.

Even better results are expected on the 1958 and 1959 high school graduation classes, primarily because of big increases in school enrollments predicted for the future.

Hulse and Van Dyke stated that among high school students there is a great lack of knowledge about A&E mechanics field because most of the aviation education given emphasizes piloting. When students are queried about mechanics as a vocation, the majority immediately think of automobile work. Emphasis on aviation is played down even in vocational schools, according to Teterboro School of Aeronautics. In Paterson vocational school, only eight boys took up aviation train-

Academy Revises Curriculum

New York—Revision of basic curriculum is being made by Academy of Aeronautics, LaGuardia Field, to keep pace with aviation industry trends and new requirements for graduates.

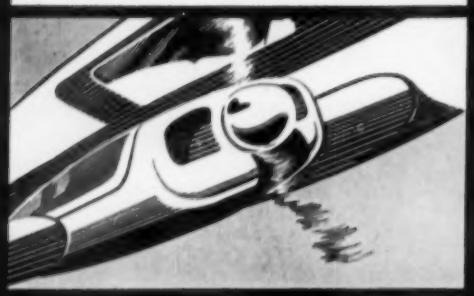
Starting this September, the Academy will inaugurate two new courses: aircraft electronics technology and industrial technology. First will comprise 1½ yr. of basic aerodynamics and structures and a year of missile and aircraft electronics with emphasis on control and guidance systems. Basics of radio and navigation electronics will be included.

Second new course will consist of 1½ yr. of basic aerodynamics and structures and a year of manufacturing techniques to bring students abreast of latest methods used by the industry.

Revisions to update its previous courses are also being made, these being re-named aircraft design technology and airframe and powerplant technology. Maintenance courses will place greater emphasis on turbine powerplants; the school recently purchased 10 jet engines for training use, including J47, J35, J34, J33 and J30.

Lecture and laboratory instruction on jets will be increased nearly 150% by the Academy.

Introduction of the new courses will require a reduction in registration in previous courses, since the school has been operating at near capacity. Registration in the new courses will be 75 students each; the school's normal total day-and-night enrollment runs approximately 1,200 students. This is an increase of about 300 prior to its facilities expansion two years ago.



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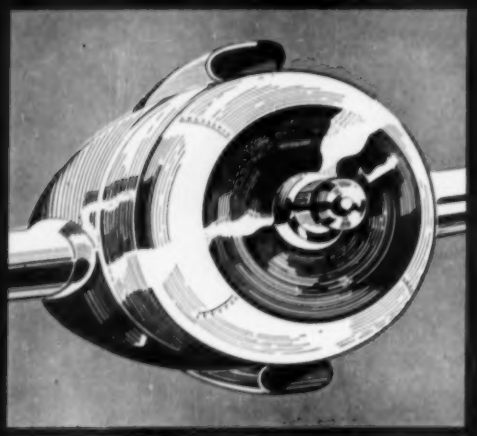

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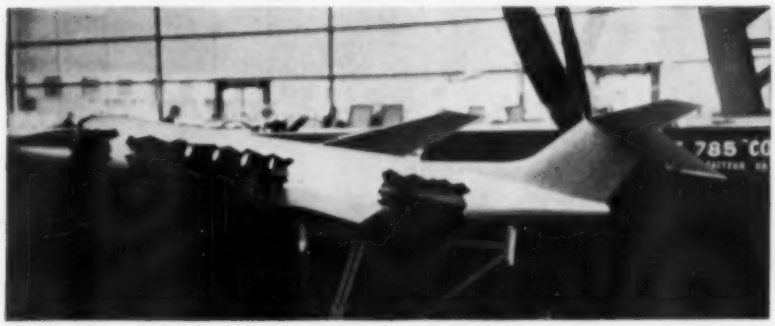
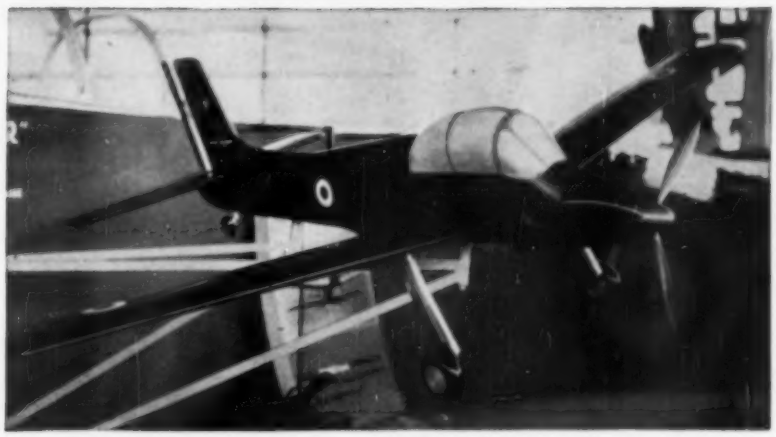




Jet Business Plane, Liaison Plane Projects

Two new Morane-Saulnier turbine-powered projects under development are the Comte de Nice (top) four-jet eight-passenger business plane and the MS-1500 Epervier light ground support-liaison plane to be powered by a Turbomeca Bastan turboprop. Comte de Nice, a design study for which production plans are not yet firm, would carry its Turbomeca Gabizo jets in pods slung beneath the 30-deg. swept wings. High-mounted T-tail is reminiscent of company's MS-760 Paris four-passenger executive twin-jet. Prototype of MS-1500 is being built for French army. It will have a speed of 206 mph. and endurance of four hours at 10,000 ft. which can be increased to 7.5 hr. carrying external auxiliary tanks. Gross weight will be 5,500 lb., span 42 ft., length 33 ft.

ing out of the entire student body, the firm states.

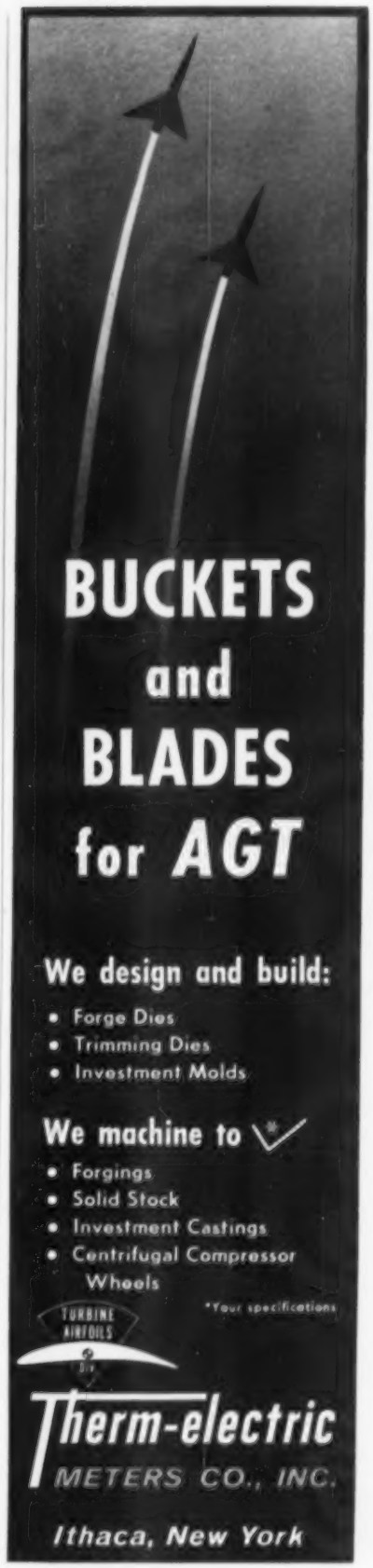
Currently student enrollment at TSA runs about 55% Korean war veterans and the remainder non-vets. These percentages are expected to reverse after September. Non-vet enrollment has shown steady increase since cut-off of World War II GI Bill benefits in 1951. On A&E training, school charges $70 monthly for day school, $35 monthly for the night course, for a total cost of $1,238. Korean vets undertaking A&E training are reimbursed by the government at the rate of $110/month if they are single; $135/month with one dependent; $160/month with two dependents. Benefits for flight training are 75% of the cost of the curriculum.

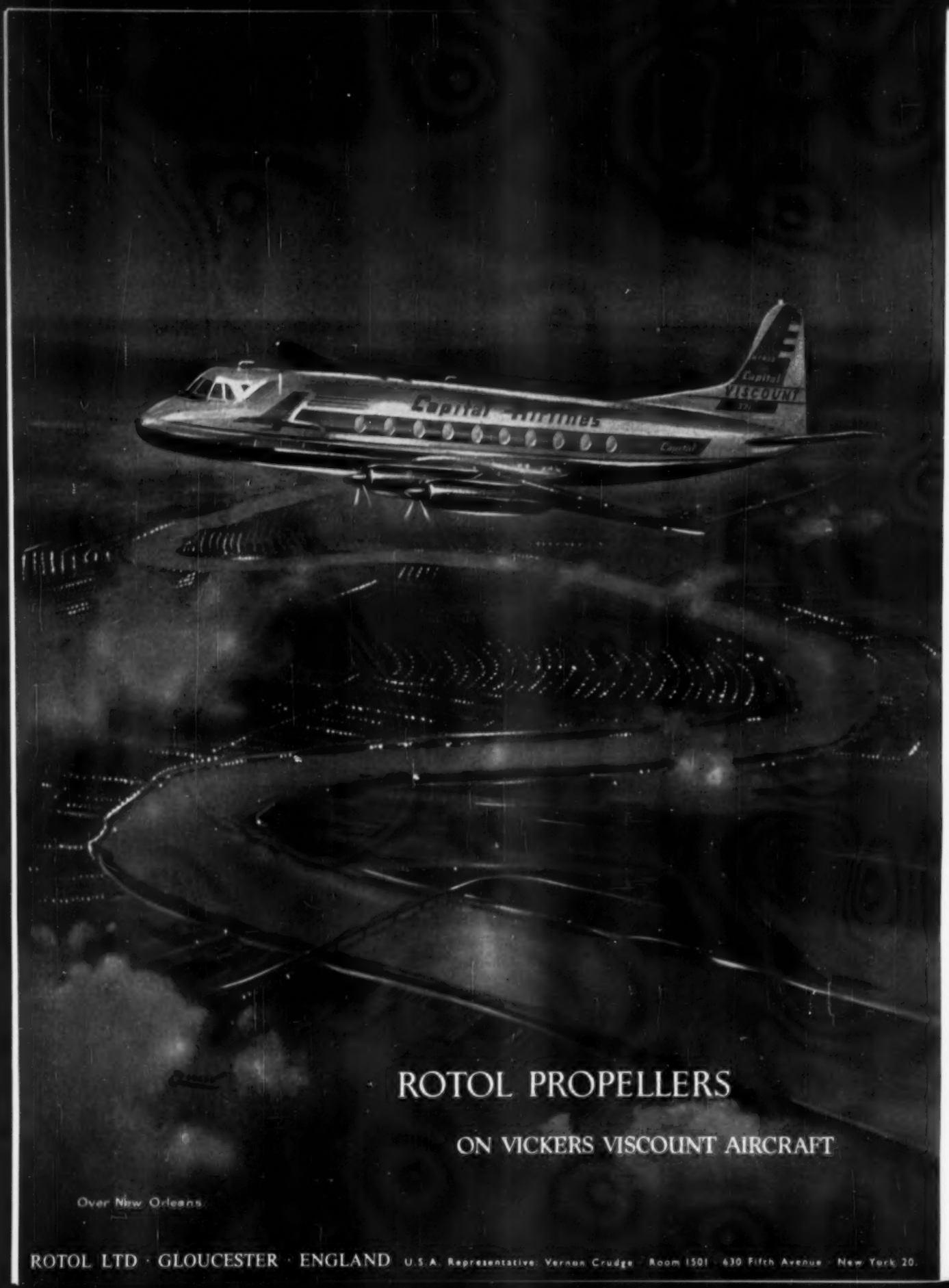
When the new facility is available, Teterboro will expand its curriculum to include flight engineer training. In the planning stage is a jet-engine specialist course to meet airlines requirements for maintenance personnel for the jet era. School has some mockups now, its instructors are qualified. It currently gives A&E students a general two-weeks familiarization study on jets.

Lack of space forced Teterboro to rent classroom space for primary engine and propeller courses and hangar space for its 12 trainers in Atlantic Aviation's facility—these will all move to the new building on its completion.

Airplane fleet consists of 10 Cessna 120s and 140s and two Piper Tri-Pacers. Rising student enrollment, growing about 20% annually, keeps them busy; they put in about 1,000 hr. in one recent month.

The school favors the side-by-side trainer, one major reason it uses the Cessnas over lighter tandem types. Other reasons: they need an airplane with starter and generator and sufficient 2-way VHF radio to operated in the busy area. They also feel that the heavier airplane, requiring more skill to operate than lighter types, results in a better finished product. They prefer tailwheel landing gear for the same reason.





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Lodestar Modification Increases Speed

Dallas—New $5,000 modification package for the Lockheed Lodestar is offered by Dallas Aero Service as a low-cost means of increasing the transport's speed.

Dallas Aero modification of the Lodestar's wings and tail produces a speed gain of about 15 mph. Other modifications offered can increase speed as much as 30 mph. Company calls the $5,000 package the cheapest speed gain available to Lodestar operators, estimates that a Lodestar operator can pay for the basic modification—tail and wing changes—in about a year through operating economies.

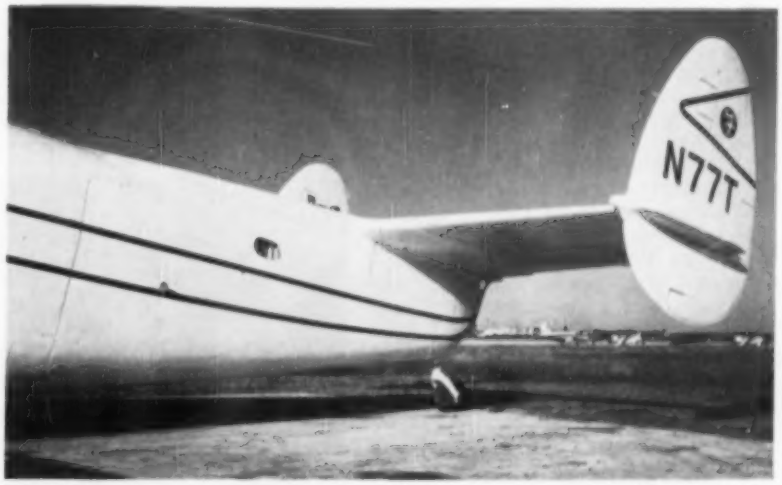
Other advantages listed by Dallas Aero for the wing and tail changes are faster climb and descent; the aircraft is more stable in rough air and requires less retrimming because of passenger movements.

Modifications improve landing characteristics and give the Lodestar better stability in landing. And the short stacks make the transport quieter.

So far, four executive Lodestars have been modified, including those of Harvey Firestone IV, Renwar Oil Co., El Paso Natural Gas Co. and Suntide Oil Co.

Dallas Aero can complete the modification in less than two weeks.

'BATWINGS' are removed from Lodestar trailing edges by Dallas Aero. Company also offers powerplant change to more powerful R1820-56 as an optional part of program.



'SADDLE' atop rear of fuselage permits streamline mounting of stabilizer which has incidence increased to 1.5 deg. Fairing also houses radio compass installation.

Tail Revised

Bulk of the changes in the package are in the tail area. Incidence of the horizontal stabilizer is raised from zero degrees to 1.5 degrees, and a saddle is installed to fair the stabilizer into the fuselage.

This change in stabilizer incidence does away with the Lodestar's elevator droop.

And the saddle has a radio compass antenna in it, permitting removal of the external antenna from the nose area, further reducing drag.

Round tips of the horizontal stabilizer are cut off, slightly reducing the stabilizer's span and leaving it with squared tips.

Streamlined protrusions are installed at the intersections of the horizontal and vertical stabilizers. These protrusions cut drag by eliminating the large flat area at the intersections. Elevators are modified by the installation of gap seals.

There is only one change in the wing area.

Dallas Aero takes off the Lodestar's batwings and installs a streamlined trailing edge.

These wing and tail modifications complete the $5,000 package. All the changes have supplementary type certificates.

In addition to the wing and tail modification package, Dallas Aero will modify the exhaust system by removing the old heat exchangers and installing DC-3 type exhaust manifolds and short stacks.

Carburetor heat system also is modified so that it meets the latest CAA requirements.

New Janitrol system, which costs $6,500 with automatic controls, is installed.

Engine Change

The conversion firm also offers an engine change to go with the other modifications.

It feels that the Wright R1820-56 engine is a more efficient powerplant for the Lodestar than the standard R1820-87 engine and will install the more powerful -56 engines along with other changes.

The Lodestar normally can't use more than 1,200 hp. for takeoff, but the -56 engines provide greater power when the airplane is cruising at 65% of rated power. If Lodestar operators want more takeoff power, Dallas Aero can install rudder spring tabs which permit use of 1,350 hp.

New Weather Service For Business Pilots

New York—New aviation weather forecasting service especially geared to the needs of individual business and private pilots operating from the metropolitan New York-New Jersey area and vicinity is being offered on a subscription basis by a private firm based at Newark Airport, N. J.

National Weather Forecasting Corp.'s service is evidence of a trend in recent years toward growth of similar operations in other parts of the country. Reason: business pilots have been increasingly handicapped in getting material they need from the U. S. Weather Bureau because budget restrictions have

prevented adequate increase in the agency's requirements for personnel and equipment.

Affiliated with Newark Air Service, major business plane base at Newark Airport, NWF will provide several types of aviation weather advisories to subscribers:

Spot briefing (currently weather forecaster is on duty from 5 a.m. to 7 p.m.; service will go on 24-hr. basis in fall), briefing at regular scheduled times on any day, either daily, semi-weekly or monthly, or on a one-time basis.

Additionally, two-, three- or four-day forecast and picture maps are available 48 hr. in advance.

Subscription rates depend upon frequency of service required; a minimum charge of $25 monthly is standard.

NWF maintains a detailed file on each subscriber so that it can tailor its service to fit the characteristics of his equipment and abilities. Some of the data recorded includes type of airplane, range, pilot ratings, landing minimums, plane ceiling, hours of flight averaged monthly, average length of flight by hours and miles, anti-icing equipment available, type of navigation equipment, whether radar is installed and other such information.

Here's how it works: a subscriber phones using non-listed number and gives his personal code number. Using the data card for reference, the duty forecaster provides weather information tailored to the customer's equipment. National provides a "confidence" factor of 98% on its reports for the first 24 hr. of its forecasts.

Subscribers can get a detailed pictorial weather profile for planning and en route study.

Headed by Harry Van Liew, United Air Lines captain, NWF is staffed by airline-and-service-experienced flying and meteorology personnel.

Van Liew plans to enlarge NWF's scope to retain regular commercial airline pilots who, at the end of their trips, will report to the private service actual wind and weather conditions encountered during their scheduled runs.

NATA Develops Code For Maintenance Bases

Practices recommended for maintenance bases in dealings with business and private aircraft owners have been developed by National Aviation Maintenance Council-National Aviation Trades Assn., and are being distributed in folder form to the organization's membership.

In pointing up the importance of establishing clear-cut procedures aimed at eliminating misunderstandings with all customers, down to the small-plane user, NAMC Chairman A. Biederman noted that many large corporate users have established their own maintenance facilities because they felt outside bases were inadequate.

Council expects also to develop a set of recommended procedures to be followed by customers in their dealings with overhaul facilities.

Piper Found Not Guilty Of Alleged Negligence

Williamsport, Pa.—Piper Aircraft Corp. was found not guilty by the U.S. District Court here in a $529,000 lawsuit brought against the Lock Haven business plane manufacturer by the families of three persons killed in crash of a Pacer near Decatur, Ga., in August, 1950.

Company had been charged with negligence in design, fabrication and inspection of outboard aileron hinge bracket, alleged to be a contributing factor in the crash.

The case was the first instance in which Piper had been sued for alleged structural failure of one of its aircraft, according to a company source.

PRIVATE LINES

Earnings of National Aeronautical Corp. (Narco), Ft. Washington, Pa., were up 91% for the first six months of the company's fiscal year. Sales were a record $2,040,000, up 72% over the same period the previous year. Steady increase in sales are forecast by President James M. Riddle, Jr.

Cooperative flight information pool will be set up by Central American airport towers at Tegucigalpa, Honduras, to maintain data on ETAs of private and nonsked airline aircraft moving through the area, thus speeding searches for overdue pilots.

VHF transceiver, crystal-controlled and transistor-powered, covers 60 channels and sells for $695 complete with all crystals, cable and antenna. Executive 60 complements Executive 90 model with 90 channels selling for $795 complete. Units developed by Wright Airborne Electronics, Kansas

Camera-Carrying Drone

New Beech 1013 pilotless reconnaissance drone is suitable for day-and-night work, carrying cameras or television equipment for surveillance of battle area. Heavier version of XKDB-1 vehicle being tested by Navy, Model 1013 weighs 800 lb. gross, is powered by a 110-hp. McCulloch engine. Operational speed is 260 mph. and ceiling is 22,800 ft. New model has endurance of 74 min.; earlier XKDB-1 endurance is one hour. Both models are adaptable to ground, ship or air launch. Closeup (right) shows camera installation.

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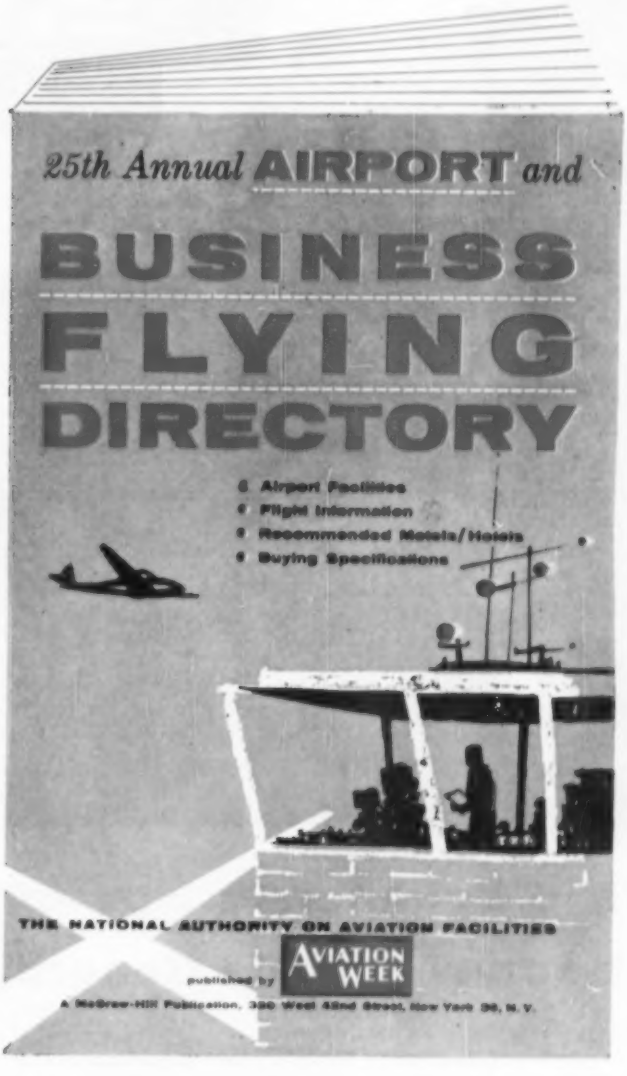

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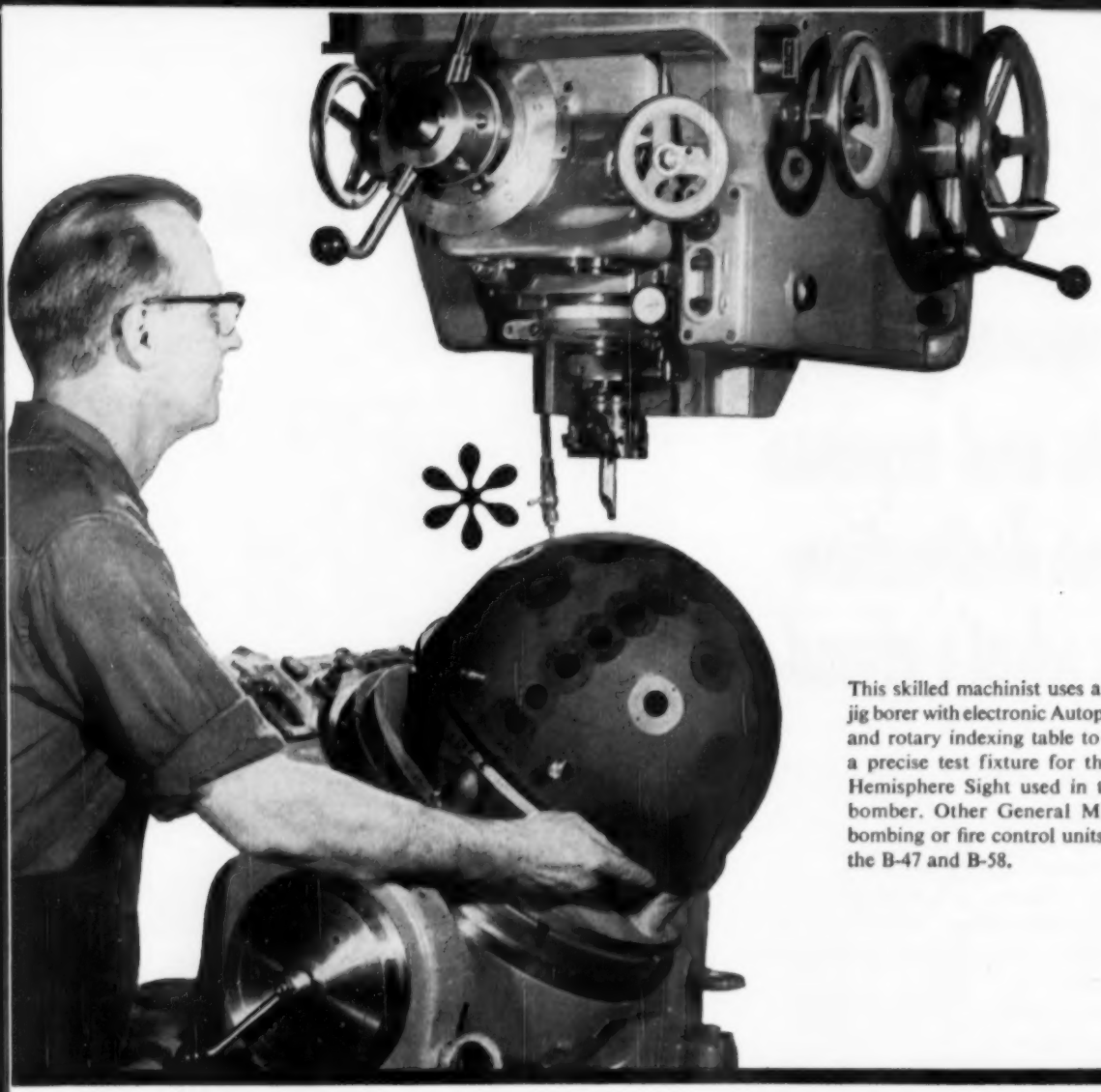


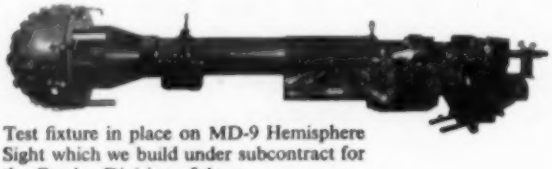
This skilled machinist uses a Lindner jig borer with electronic Autopositioner and rotary indexing table to produce a precise test fixture for the MD-9 Hemisphere Sight used in the B-52 bomber. Other General Mills-built bombing or fire control units fly with the B-47 and B-58.

*B-52 gunners are better marksmen because of this General Mills craftsman

Maintaining accuracy of the MD-9 Hemisphere Sight for the tail defense system in B-52 bombers calls for unusually close tolerances. Holding these tolerances requires exacting test fixtures. We designed, engineered and built many of them.

The optical device in the picture has flat, microfinished surfaces with angular accuracy within two minutes of arc surrounding lens openings. The critical flat areas and openings are located from bearing holes that are held within $+.0002''$, $-.0000''$.

We'd like to tell you more about how we combine creative engineering and fine precision production to serve industry and military. Our unified team can handle research, development or manufacturing—or the whole package. Send for facts, Dept. AW7.



Test fixture in place on MD-9 Hemisphere Sight which we build under subcontract for the Crosley Division of Avco.

MECHANICAL DIVISION General Mills

Minneapolis 13, Minnesota

CREATIVE RESEARCH AND DEVELOPMENT • PRECISION ENGINEERING AND PRODUCTION

City, Mo. New models weigh less than six pounds, measure 4¾ in. x 6¼ in. x 9¾ in.

Additional Trecker Gull twin-engine amphibian was added to Commodore Aviation taxi air service between Lake Tahoe and San Francisco to meet demand for seats. Commodore offers 16 daily flights between the two points, with one-way fare of $19.50 plus tax, children under six at half fare, those under two, free.

Rudder and elevator spring tab system developed by Howard Aero Service for Super Ventura will be used on Minnesota Airmotive's Super Lodestar conversion (AW May 28, 1956, p. 105) under agreement with Howard.

Reading Aviation Service, Pa., is new distributor and installation center for Safe Flight Autopower system which automatically corrects engine throttles to meet airspeed and wing lift conditions selected by pilot.

Piper will roll out its 45,000th airplane Aug. 12. To celebrate the production milestone, the Lock Haven, Pa., business plane maker invites pilots and their guests to an open house and luncheon at its airport Aug. 17th. Featured will be tours of 10-acre plant and display of latest private plane models, including recently certificated Comanche.

USAF overhaul contracts totaling $17 million have been awarded Flight Enterprises, Inc., Bradley Field, Conn. Contracts come to $5 million more than handled by firm last year and are four times greater than those received two years ago. Flight Enterprises will open a new division at McGuire AFB, N. J., and utilize its subsidiary divisions in Charleston, N. C., to handle USAF workload. Employes will total 3,000 at its three bases soon and will probably increase to 4,000 by year's end.

Cessna signed two-year agreement with International Association of Machinists Local Lodge 774, providing seven cents hourly wage increase with June 30, 1958 wage reopener; seventh paid holiday; company-paid retirement plan starting Oct. 1, 1958; seniority division-wide basis and longevity pay on company-wide basis. New benefits total $1.3 million annually for the firm's 5,300 employes.

First 15 of 90 Beech T-34 Mentor trainers ordered by Argentina has left Wichita, Kans.; remaining planes of the order will be shipped disassembled to the government factory in Cordoba. About half of the trainers will be equipped with armament. Total contract is valued at $4 million.

Atlantic Aviation Service, Inc., Philadelphia (Pa.) International Airport, is distributor for Doman LZ-5 helicopter, covering Eastern seaboard from Canada to North Carolina.

PBY Catalina conversions have been resumed by Southern California Aircraft Corp., Ontario, following facilities expansion necessitated by USAF IRAN contract work.

Month's tour of DC-3 fitted with AiResearch "Maximizer" kit will cover 10,000 mi. across the U. S. and Canada. Over 40 DC-3s have been fitted with kit, which is guaranteed to increase airplane's speed 20 mph. with no increase in power.

Ground was broken on $1.5 million airport for business and private flyers at Olean, N. Y., scheduled for operation July 1958. Field will have 5,000-ft. paved NE-SW and 2,500-ft. turf NW-SE runways.

USAF designated Aircraft Engineering & Maintenance Co., Oakland, Calif., as a flight sampling plant, a plan under which USAF pilots flight test sample aircraft rather than each plane, customary under normal procedures. AEMC is reported to be the first Air Force aircraft overhaul contractor to receive this classification.

Relaxation of aircraft import restrictions by Australian government is underway and import licensing authorities are being instructed to take more liberal view toward purchase of lightplanes from abroad. Government also has approved acquisition of two Piper Apache light twins for weather research by Commonwealth Scientific & Industrial Research Organization formerly held up by import restrictions.

Executive aircraft operators have purchased over $300,000 worth of Sperry integrated flight systems providing pictorial representation of needed data.

Fairchild F.27 with later Rolls-Royce RDA.7 Mk.525 turboprop engines, rated at 1,800 shp., will be available for delivery beginning January 1959. With the new powerplants, the F.27's maximum rate of climb is increased to 1,770 fpm. from 1,480, with one engine out. Service ceiling will be 16,000 ft. Fourteen U.S. and Mexican corporations have ordered executive versions of Friendship.

Modernized T-6 Starts Flight Tests

Major cleanup of famed North American T-6 Texan trainer by West Coast operator Earl Bacon resulted in cruise speed of 209 mph. TAS at 54% power at 10,000 ft. during recent flight test near Los Angeles. Climb was better than 1,000 fpm. Modernization resulted in reducing empty weight about 200 lb. to 3,740 lb.; gross weight on flight pictured was 4,666 lb. compared to 5,400-lb. legal gross weight for T-6 type. Rework includes extensive revisions in the engine area, including improved cowl, removal of engine exhaust collector ring. Canopy is now one-piece for improved visibility. Tricycle landing gear is lighter than previous tail-wheel gear. Additional range is obtained from Cessna 310-type wingtip tanks.

Is Industry Creating A New Breed of "Bonus Babies"?

THE STARTING SALARIES offered to this year's June graduates give the impression that industry is creating a new breed of "bonus babies." This is the term baseball fans apply to sturdy youngsters whose talent for hitting and throwing gets them payments of up to $100,000 and other benefits for signing a contract.

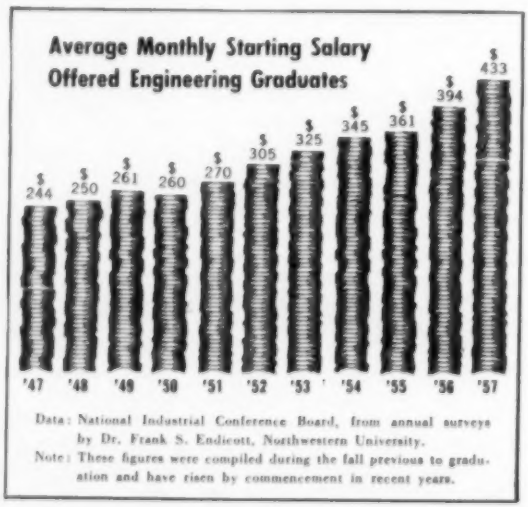
For several years industry's demand for young college graduates, especially in science and engineering, has outrun the number receiving degrees. Competition for these young people has steadily pushed up the starting salaries and has induced many companies to indulge in lavish recruiting programs. This year engineering graduates are being offered well over $400 a month, and even liberal arts graduates find numerous offers at $400 or more. Only ten years ago the salaries offered senior engineering students averaged less than $250 a month.

But any employer who assumes that high starting salaries alone will assure him the number of June graduates he wants is likely to be disappointed. A recent study by the McGraw-Hill Classified Advertising Division shows that most young engineers and scientists going into industry are more interested in their opportunities and in a company's future than they are in the size of their first paycheck.

Money Isn't Everything

In the McGraw-Hill survey, 2,596 recently-hired engineers and scientists employed in 57 companies listed the factors they had considered before accepting a position. The replies of the younger engineers and scientists—those with less than five years' experience — have great significance for employers who want to make any impression in the highly competitive market for college graduates.

- **Potential growth of the company** was listed by more young engineers and scientists than any of the 42 other items on the list as a factor that influenced greatly their decision in accepting a position.
- **Challenging opportunity** was second.
- **The company's prestige and reputation** ranked third.



Data: National Industrial Conference Board, from annual surveys by Dr. Frank S. Endicott, Northwestern University.
Note: These figures were compiled during the fall previous to graduation and have risen by commencement in recent years.

● **Progressive research and development program** was fourth.

● **Starting salary** ranked only **seventh.**

Job and Future Most Important

As a group, the factors relating to the nature of the job, its future and the company's future had by far the greatest influence in attracting young engineers and scientists to their present positions. These include three of the top four attractions—potential growth of the company, a challenging opportunity and a progressive research and development program. Other factors in this group are the company's facilities, quick advancement, self-direction or little supervision, chance to work in a certain field, small size of company and rewards for individual accomplishment.

The second most important group of attractions had to do with prestige. These include the company's prestige and reputation, executive or professional standing and association with leading men in the field. **Third in importance were financial considerations**—starting salary, regular salary increases, financing of relocation, paid vacations and holidays.

A less important group of factors influencing young scientists and engineers were essentially social. Geographic location and educational facilities in vicinity ranked fairly high. But recreational facilities, suburban or country living, pleasant housing and cultural considerations had little appeal.

Ranking lowest, by a good margin, were factors having to do with security—permanent position; health, life and surgical insurance; retirement or pension plan; and sick leave.

It is interesting to note that some of the factors which influenced the **smallest** percentage of young engineers and scientists were country club memberships, use of company car, at-cost or low-cost eating place, travel opportunities abroad and being able to buy the company's products at a discount.

A Lesson For Employers

The lesson of this survey to employers who hope to recruit more young engineers and scientists is clear. High salaries and other financial appeals are important. But, **at a time when high starting salaries are offered in abundance, our young graduates are interested even more in being with companies that will grow and in jobs that will permit them to grow. They are interested in jobs that offer opportunities for advancement, financially and professionally.**

* * *

Were the young scientists and engineers who participated in the survey trying to impress somebody with their motives? If so, it could only have been to impress themselves, for all were asked to return their questionnaires unsigned.

What Factors Influence the Job Selections of Young Engineers and Scientists?

Factors Influencing Decision Greatly	Percent Listing Factor
Potential growth of company	55%
Challenging opportunity	53
Company's prestige, reputation	44
Progressive research and development program	41
Geographic location	37
Permanent position	35
Starting salary	34
Educational facilities in vicinity	33
Regular salary increases	31
Chance to work on specific project, or in certain field	27
Company's facilities (laboratories, technical libraries, etc.)	25
Tuition for graduate study	25

Based on replies by recently-hired engineers and scientists with less than five years' experience to questionnaire distributed by McGraw-Hill Classified Advertising Division.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nation-wide developments. Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.

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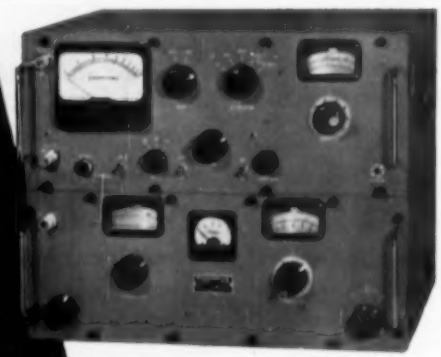
107-A TEST SET and FIELD INTENSITY METER



The 107-A Test Set and Field Intensity Meter combines in one portable unit a radio receiver of laboratory quality with metered output and an accurately calibrated signal generator. These instruments, which can be used separately for a variety of test purposes, cover a frequency range of 54 to 240 megacycles without band changing.

SPECIFICATIONS

RECEIVER

- Input Impedance ..... 51 ohms
- I.F. Frequency ..... 21.4 MC
- I.F. Bandwidth ..... 200 KC
- Sensitivity at input term. as a voltmeter 1.0 uv
  - Field Strength at 54 MC ..... 1.6 uv/m
  - Field Strength at 240 MC ..... 6.5 uv/m
- Max. input using external pad supplied 10.0 V
  - Field Strength at 54 MC ..... 16.0 V/M
  - Field Strength at 240 MC ..... 65.0 V/M
- Output Indicator ..... Panel meter (approx. Logarithmic scale)
- Output: 1. To operate at 1.0 milliampere recorder. 2. Audio for headphones.

SIGNAL GENERATOR

- Output ..... 1.0 uv to 0.1 V
- Output Impedance ..... 51 ohms

POWER REQUIREMENTS

- 117 volt a-c, 50-400 cycle ..... 60 watts—or
- 6 volt, d-c ..... 8 amperes

NEMS CLARKE

Incorporated

919 JESUP-BLAIR DRIVE SILVER SPRING, MARYLAND

For further information write Dept. P-3

WHO'S WHERE

(*Continued from page 23*)

Changes

J. F. Allen, manager, Guided Missile Plant, Cameron Iron Works, Inc., Houston.

Donald M. McDowell, engineering manager, Le Roi Division, Westinghouse Air Brake Co., Milwaukee, Wis.

Robert H. Wilcox, superintendent-experimental operations, Connecticut Aeronautic Nuclear Engine Laboratory, Pratt & Whitney Aircraft Division, United Aircraft Corp., East Hartford, Conn. Also, **George Molchan,** purchasing manager, and **Edwin L. Davis,** contract administrator.

William F. Tyson, general sales manager, Van Dusen Aircraft Supplies, Teterboro, N. J.

John Brophy, sales coordinator-commercial airlines, Aircraft Equipment Division, Consolidated Diesel Electric Corp., Stamford, Conn.

Maurice Keating, Jr., chief pilot, Pacific Northern Airlines, Inc.

E. Spencer Garrett, passenger traffic superintendent, Pacific-Alaska Division, Pan American World Airways, Inc.

John R. Strobel, sales engineer-Denver, Colo. branch, The Garlock Packing Co., Palmyra, N. Y.

Isaack Herman, general manager, Electrical Communications, Inc., San Francisco.

John A. Curtis, sales manager, Avion Division, ACF Industries, Inc., Paramus, N. J.

Harry Horne, corporate planning director, Marquardt Aircraft Co., Van Nuys, Calif.

Denzil Merrill, airport and visual aids specialist, Air Transport Association of America, Washington, D. C.

Sterling B. Estes, aircraft sales manager, Field Aviation Company Ltd., Toronto, Canada.

Gene F. Erbin, West Coast technological representative (Los Angeles), Titanium Metals Corp., New York, N. Y.

Richard M. Fielding, manager-public information, Government & Industrial Division, Philco Corp., Philadelphia, Pa.

Max Moore, chief engineer, Precision Potentiometer Division, General Controls Co., Glendale, Calif.

Carl Seybold, engineer-plastics specialist, Radioplane Co., Van Nuys, Calif.

Group Capt. Gordon Slade, superintendent of flying, and **Peter Twiss,** chief test pilot, the Fairey Aviation Company Ltd., London, England.

Jesse L. Boynton, regional director-middle east and Asia (Beirut, Lebanon), Pan American World Airways, Inc.

Von D. Miller, design engineer-product development dept., Kaylock Division, The Kaynar Co., Los Angeles, Calif.

Albert W. Dunn, manager-aviation products dept., Goodyear International Corp., Akron, Ohio.

S. R. Sartore, staff engineer-weapon system test management dept., Missile Systems Division, Lockheed Aircraft Corp., Sunnyvale, Calif.

Thomas Lamb, aircraft power-plant engineer, Pacific Northern Airlines, Inc.

Eugene V. Gustavson, director of engineering, Aeronca Manufacturing Corp., Middletown, Ohio.

CAPABILITIES . . . Manpower, Tools and Experience

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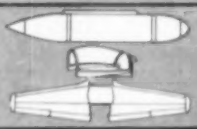
	MA-3 MULTI-PURPOSE VEHICLES
	C-26, MD-3 POWER UNITS
	TANK-WING-MAJOR SUBASSEMBLY SUBCONTRACT PRODUCTION
	BEECHCRAFT T-34 TRAINERS
	BEECHCRAFT L-23 TRANSPORTS
	4-PLACE BEECHCRAFT BONANZA
	6-PLACE BEECHCRAFT TWIN-BONANZA
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Or, write in complete confidence to:
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Professional Placement

JET ENGINE DEPARTMENT

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GENERAL ELECTRIC

Cincinnati 15, Ohio

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Positions Wanted | **Selling Opportunities Wanted** | **Employment Services**
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GENERAL ELECTRIC

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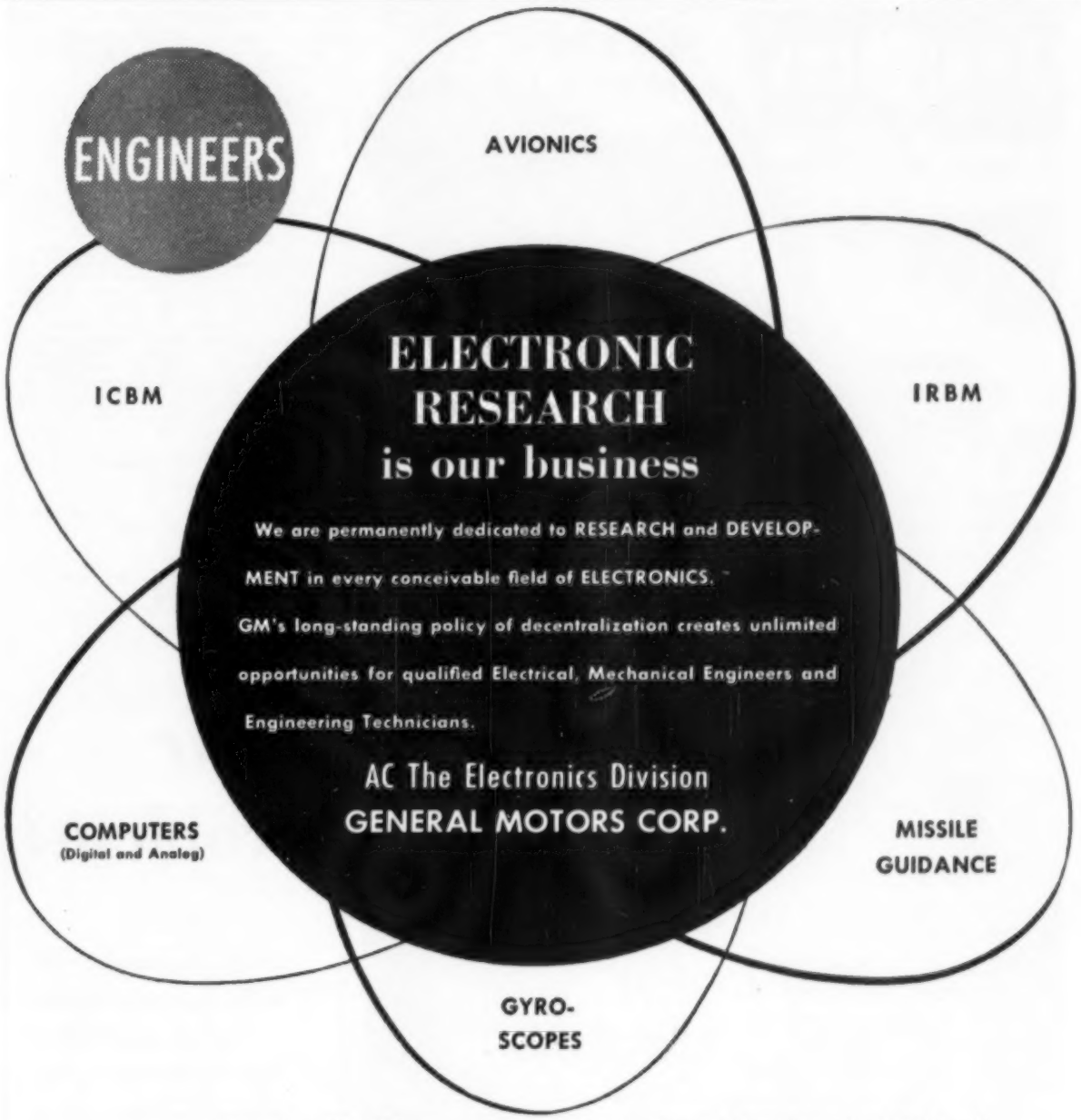
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GENERAL ELECTRIC

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CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)
LOS ANGELES: 1125 W. 6th St. (17)

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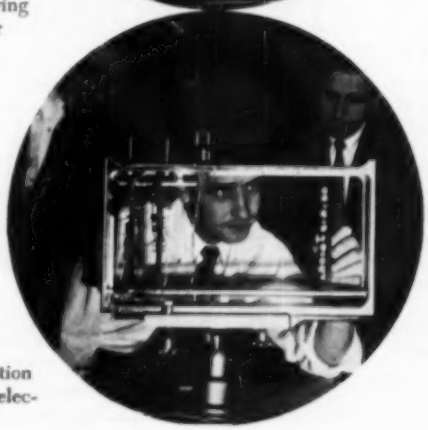

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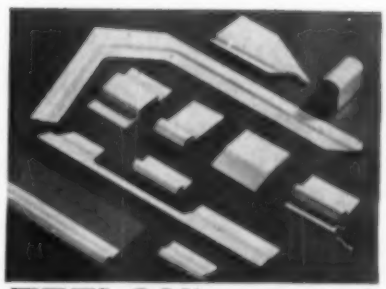

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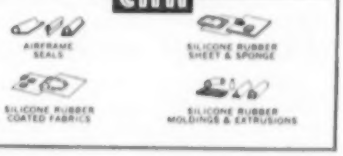

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LETTERS

B-52 Crash

I read with interest your article entitled, "Air Force Will Switch Drives in B-52," in the June 24 issue (p. 81) of AVIATION WEEK. This article contains a statement as follows:

"One report on this crash said that loss of electrical power when the drive overheated and seized under negative G loading caused the accident."

I have before me the pneumatics, hydraulic and air conditioning report covering the aforementioned incident. Page 5 of this report analyzes the four Sundstrand drives. In no case was there a report of overheat or seizure, and in every case the mechanical components of the drive were in excellent and operable condition except for impact damage.

In view of these statements by the investigating group, I believe that the quoted statement should be amended to conform with the actual findings.

P. A. ANDERSON
Contracts Manager
Sundstrand Aviation

Comment on Drives

Robert Cushman's article on B-52 Alternator Drives (AW June 24, p. 81) is well written. The pros and cons of the hydraulic and pneumatic means of driving the system alternators appear to be well covered, with one possible exception. I would, therefore, like to inject the matter of transient response—the ability of each type of drive to recover from a normal or abnormal "shock load" such as might be presented when starting a large electric motor, or the simultaneous switching on multiple electrical loads.

Reference is made in the article to "hard and soft" drives. The hydraulic drive is a hard system, sometimes called a "stiff" drive; as such, I believe that during transient loading conditions, the A.C. frequency droop and subsequent recovery to normal is less of a problem than with the "soft" or pneumatic systems. This is particularly true when the drive must also supply torque to a hydraulic pump, the shock loading of which is reflected into the electrical system frequency.

Reference is made to "The four Sundstrand 40 kva. alternators. . . ." Inasmuch as the article impartially discusses features and opinions of G.E., Vickers, Thompson, etc., regardless of the type of drive, Westinghouse A.C. generators (alternators) are used exclusively on the B-52—also on the KC-135, B-47, "707" and, oh yes, on the B-36.

ROBERT W. SUMNER
Field Engineer
Westinghouse Electric Corp.
Los Angeles, Calif.

Twice Burned

To continue with the Petrel carrier or Mountain-Out-Of-Molehill Department or Mistaken, Mistaken identity—in AVIATION WEEK, June 17, p. 33 and July 8 Letters, p. 154—may I, a humble subscriber, submit the following:

(a) Collect on that Petrel bet offered by Chief Pilot Lewis of Thatcher Glass.

(b) It was a P4Y, Privateer, carrying the Petrel.

(c) The P4Y was formerly designated PB4Y-2.

(d) The PB2Y was a four engine seaplane.

(e) An arched eyebrow to the editor for his "PB2Y-4."

(f) We may possibly qualify as experts since we turned in our last P4Y several days ago on a new model P2V, Neptune.

JOHN F. PLACE, LCDR
Operations Officer
Naval Reserve Patrol Sqd. 831
Naval Air Station, N. Y.

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Combined Operations

A suggestion to the Disgusted Engineer (AW July 8, p. 154) titled, "Working Time 30%."

Why not do as we have done: combine your bull sessions with ogling the girls. This combined operation accounts for only 20% of our time (besides giving the gals the feeling of being admired en masse). Now, allowing the same 30% for working time, this then permits us to have half the working day to relax in.

However, being very busy, we do our relaxing after hours (without pay, of course).

Besides, in an outfit such as you describe, who wants to get ahead anyway!!

"SATISFIED"

Fat Force?

Many thanks for publishing the "Surplus or Shortage?" letter from A (Happy) Jobshopper in your May 20 issue (p. 158) of AVIATION WEEK.

From what I have observed in recent years the acceptance of the facts and recommended solutions to the engineering problem, as stated by Mr. Jobshopper, by all fields of R&D would cut much fat from the ever growing porker that is usually disguised as an underfed engineering force within our industrial potential here in the U.S.

I for one nominate Mr. Jobshopper for a job at the Defense Department level.

CDR. MAX V. RICKETTS, USN
Norfolk, Va.

'Chauvinism' Retort

I have just received my June 10 issue of AVIATION WEEK, and I want to take up with you the reference in your editorial to ". . . the narrow chauvinism of the Farnborough display. . . ."

International air displays and exhibitions are fine, and on the continent of Europe they have an especially important value in demonstrating the strength and solidarity of NATO and the might of American airpower within it.

Of course, the Paris Show which you and I were watching 11 days ago was outstanding in this respect. It is very much of a show for the public.

The S.B.A.C. Display and Exhibition has an entirely different purpose. Except for the war years we have run it annually since the early 1930s, and it is the shop window of the British aircraft industry.

There is no question of narrowness or chauvinism in a traditional national event, and I would have thought that you would appreciate that.

For many years the Federation of British Industries has held a great annual exhibition, particularly designed to show the products of British industry to customers visiting England from abroad, so that they can compare the values of competitive British producers.

Many individual industries do this. Are they guilty of a narrow chauvinism? Surely the same sort of sales effort takes place in numerous other countries? What is unusual about it?

Please don't get us wrong. We have a world-wide export business of 30 years standing, and the S.B.A.C. Show has been running for more than 20 years. The limbs of our sales organisation reach out to all the export markets, and once a year our customers have this opportunity to visit us in England and after seeing the display they go the rounds of the factories and weigh up the products and the producers.

Thousands come to England for this purpose, year after year. They are technical people.

To compare this with an international display for the public, on the continent, where Western Defence is the theme (always remembering that civil aviation, as well as military, is a factor in defence) is like comparing direct business with international diplomacy.

Both are necessary.

I always feel that I can understand your thinking, and I have had a great deal of contact with America, and I would like you to see this other point of view.

MARTIN SHARP
Public Relations Manager
The de Havilland Aircraft Company Limited
Hatfield, Hertfordshire
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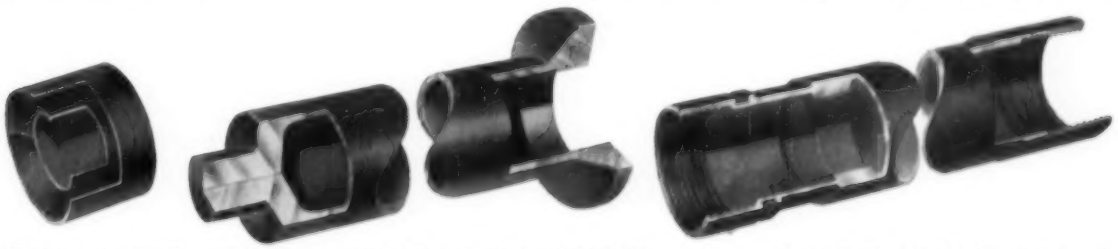

ROCKET FIN with integral guiding vanes impacted as a one-piece unit from alloy 7075-T6. This impact extrusion provides transverse physical properties equal to longitudinal properties and a high degree of dimensional accuracy with close tolerances. Similar symmetrical designs in diameters up to 10 inches can be impact extruded.

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ROCKET MOTOR TUBE with integral formed bulkhead for application in rockets. Length to 8 feet, diameter 6-8". Tube has a thicker cross-section at both ends to accommodate threading. This type of Harvey Impact Extrusion in high strength aluminum alloys offers high transverse properties for added hoop strength.

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